DOCUMENT RESUME

ED 113 154 SE 019 638

TITLE Activities. A Collection of Things to Do at the Environmental Learning Center, Isabella, Minnesota.

INSTITUTION Environmental Learning Center, Isabella, Minn.

PUB DATE [75]

NOTE 119p.; Occasional marginal legibility

EDRS PRICE MF-$0.76 HC-$5.70 Plus Postage

DESCRIPTORS Curriculum Guides; *Elementary Secondary Education; *Environmental Education; *Instructional Materials; Learning Activities; Natural Resources; Outdoor Education; Resident Camp Programs; *Science Education; Student Projects; *Teaching Guides

ABSTRACT

A collection of activities used successfully at the Environmental Learning Center in Isabella, Minnesota, are contained in this guide. Areas of study are perception and communication, mapping, weather, snow, soil, aquatics, trees, and animals. Within these areas is a number of related activities, each to be adapted to the appropriate grade level. The exercises contain a brief description with a statement of purpose. Equipment checklists indicate what the center furnishes, and what you are expected to provide. Procedures explain specifically how to go about each activity. A series of discussion questions serve as a follow up to the exercises. The lessons provide a degree of flexibility, so that they can be used when designing a resident program, or modified to accommodate individual or group needs. A number of the activities suggest the use of activity cards which can be reproduced from the lesson sample. Notebooks are also indicated as being important in most areas. Included in the appendix is a detailed account of available equipment at the center, including those items for camping, recreation, measuring, optics, astronomy, terrestrial needs, aquatic needs, test kits, and audiovisual aids. The bibliography contains a collection of materials used to develop environmentally oriented lessons. (BP)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

ED113154

SE 019 638

ACTIVITIES

A collection of things to do at the Environmental Learning Center, Isabella, Minnesota

Contents

Introduction	5
Perception & Communication	7
Maps & Areas	33
Weather	51
Snow	61
Soil	73
Aquatics	79
Trees	97
Animals	125
Appendices	157

Introduction

On the following pages you will find a collection of lessons and activities that have been used successfully at the Environmental Learning Center located near Isabella, Minnesota. They employ a variety of teaching strategies and involve a variety of disciplines.

Many of the lessons are highly structured and include time suggestions, behavioral objectives and evaluation criteria. Others are less structured and are intended to provide a degree of flexibility for the instructor. No matter which format is employed, experience has shown that extensive pre-planning and organization are the major ingredients in a successful resident learning program.

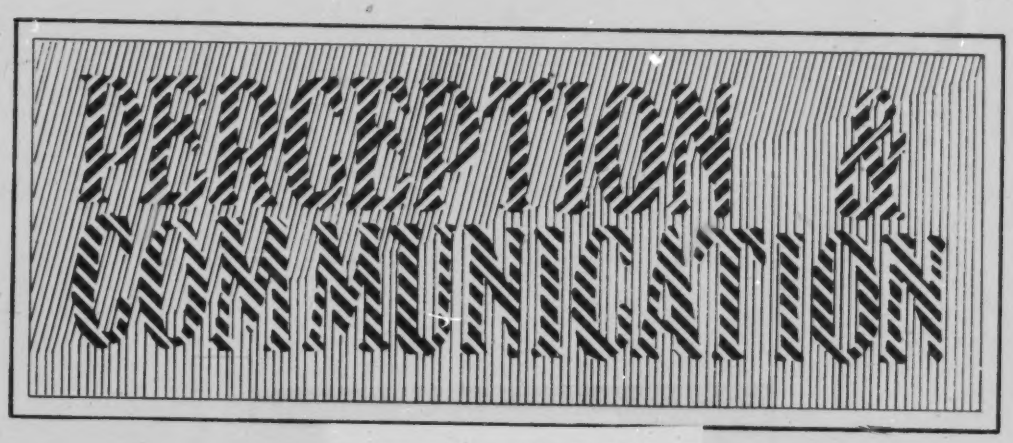
The activities located in this guide may be used exclusively when designing a resident program or they may be modified to meet group needs. Many other activites are available from a variety of sources, and range from the very structured People and Their Environment series to the broadly defined ES Cards. Both are listed in Appendix B. Persons desiring assistance in selecting curriculum for environmental education are urged to contact the Environmental Learning Center.

Many of the lessons included in this booklet suggest the use of activity cards. Should you select these lessons for your group it will be necessary to reproduce the card sample included with the lesson in the number that you will require. A student notebook can serve a similar function plus enable the student to record other aspects of the session.

Equipment lists are included for each activity. The Center will provide, whenever possible, the majority of the non-expendable equipment needs of each group. The participants are always responsible for expendable items such as pencils, paper, activity cards, paints and etc. It is recommended that a bit more than what seems to be enough of the expendable materials be brought to the Center.

Equipment use must be arranged for at least ten days prior to each group's arrival at the Center. The equipment list should accompany the activity schedule in order to insure that equipment and other facilities are available. Frequently more than one group will be using the Center at a given time resulting in the equipment inventory being shared.

There are a number of activities that are normally conducted at the Center which are not included with this activity guide. The Center has two dozen canoes with paddles and life jackets. These can be used for activities dealing with canoeing skills or in conjunction with aquatic activities. Also available at the Center are dozens of pairs each of cross country skis and snowshoes which may be used. As with all Center equipment it is necessary to arrange for their use prior to arrival.


PERCEPTION & COMMUNICATION

SOUNDS

Many students are so used to shutting out background noises that they often do not hear any sounds when they first arrive at the Environmental Learning Center other than those made by their classmates. The following activity is designed to increase a student's awareness of sounds around him.

Equipment

Center Provides	You Provide
Parabolic Receivers	Note paper
Cassette Tape Recorders	Pencils
Clipboards	

Procedure

1. Demonstrate how the tape recorder and parabolic receivers are used.

2. Have the students go outside and record:

    a. Man-made noises.
    b. Natural noises.
    c. Noises they cannot identify as man-made or natural.

NOTE: Have one student in each group write down the tape number where each sound begins.

3. Return to the starting location to play back and discuss the sounds.

Discussion

1. What was the most common sound?

2. Were there more man-made or non-man-made sounds?

3. Were there any unidentified sounds?

4. Where was the best place to record sounds?

5. What similarities did the sounds have?

6. What differences did the sounds have?

7. Would you expect more or fewer sounds at a different time of day? Why?

WINTER NATURE HUNT

Things To See

_____ Buds on a tree

_____ A feather

_____ Animal tracks

_____ A bird

_____ Snow on jack pine branch

_____ A hole in a tree

Things To Hear

_____ Wind in the trees

_____ Snow falling

_____ Animals in the brush

_____ Snow underfoot

Things To Smell

_____ Pine branches

_____ Snow

_____ Birch bark

_____ The air

Things To Feel

_____ Ice

_____ Tree bark

_____ Rotten wood

_____ The wind

_____ Prickly plant

Things Happening

_____ The wind moving snow

_____ An animal eating

_____ A bird flying

_____ Icicles forming

_____ Snow falling off trees

SPRING NATURE HUNT

Things To See

_____ Buds opening

_____ A hole in a tree

_____ A feather

_____ A wild flower

_____ A squirrel

_____ An insect

Things To Hear

_____ Wet leaves under foot

_____ A squirrel

_____ Wind in the trees

_____ The stream

_____ The rain falling

Things To Smell

_____ A tree

_____ The soil

_____ A flower

_____ Old leaves

_____ Green grass

Things To Feel

_____ Wet soil

_____ Prickly plant

_____ Rotten wood

_____ The wind

_____ Stream water

_____ Tree bark

Things Happening

_____ An animal eating

_____ A spider web with a bug in it

_____ A fish swimming

_____ A squirrel moving something

_____ A flower blooming

SUMMER NATURE HUNT

Things To See

_____ A feather

_____ Bunchberries

_____ A hole in a tree

_____ A bird

_____ An ant

_____ A butterfly

Things To Hear

_____ A bee

_____ Wind in the trees

_____ Rain falling

_____ A squirrel

_____ The stream

Things To Smell

_____ Old leaves

_____ The sand

_____ A yellow flower

_____ A tree

_____ Green grass

Things To Feel

_____ Wet soil

_____ The wind

_____ Rotten wood

_____ A mosquito bite

_____ Prickly plant

Things Happening

_____ An ant moving something

_____ A spider web with a bug in it

_____ An animal eating

_____ A flower blooming

_____ A fish swimming

FALL NATURE HUNT

Things To See

_____ A feather

_____ A hole in a tree

_____ A yellow leaf

_____ A duck

_____ Trees of different color

_____ A squirrel

Things To Hear

_____ Wind in the trees

_____ Dry leaves underfoot

_____ Squirrels chattering

_____ The stream

Things To Smell

_____ Wet leaves

_____ Dried flowers

_____ Brown grass

_____ A tree

Things To Feel

_____ Wet leaves

_____ Prickly plant

_____ The wind

_____ Tree bark

_____ Stream water

Things Happening

_____ A leaf falling

_____ An animal eating

_____ A squirrel moving something

_____ A spider web with a bug in it

_____ Colors changing

MAKING AND TRYING TO PROVE HYPOTHESES

A hypothesis is any tentative assumption which you are going to try to prove. A hypothesis can usually be stated in a simple sentence, i.e., "Moss only grows on the north side of trees". To prove this, the student who stated it would need to go out and examine several trees and see where the moss is growing. He will find out if his hypothesis is wrong, right, or right under some conditions.

Students may want to make hypotheses and then exchange them so someone else is proving (or disproving) them.

Equipment

Center Provides	You Provide
	The material for this will vary from group to group, but please notify us of what Center equipment you will need.

Procedure

In the classroom a week or two prior to your departure for the Center:

1. Have the students list various hypotheses that they would like to try to prove while at the ELC.
2. See if some of the hypotheses fall into the same catagory so students can work on them in small groups.
3. Have the students determine what they would need to do to prove or disprove their hypotheses.

At the Center:

1. In the field prove or disprove the hypothesis.

Discussion

1. Were you able to prove your hypothesis? Why or why not?

Other Sample Hypotheses:

1. Every animal and plant except man has a well-defined habitat.
2. All organisms are interdependent.
3. The environment is constantly changing.

SKETCHING AND PAINTING

There are birds, bridges, trees, lakes, streams, rapids and many other inspirations for students - and teachers - who may want to do charcoal, pen and ink or water color drawings.

Equipment

Center Provides	You Provide
Clipboards	Paper
	Charcoal
	Pen and Ink
	Water Colors
	Etc.

Pick any site in the area and proceed.

WINTER PHOTOGRAPHY

Equipment

Center Provides	You Provide
Cameras (Polaroid Square Shooter 2)	Film
Clipboards	Activity (Reproduced from the sample that is attached to this lesson)
	Pencils

Procedure

1. Have the participants gather for instruction on the use of their cameras. Quickly describe what a camera does (It allows a controlled amount of light into a light tight box. The focused light strikes a light sensitive film which, when developed, creates a picture.)

2. Discuss why people take pictures. This would include record keeping, reporting, recording of beauty, desire to hold onto fleeting, temporary images, etc.

3. Have a few people tell about some good pictures they have seen and why they thought they were good. Talk about some of the photographs the Center has on display. What makes some more pleasing than others?

4. Hand out the activity sheets and go over the kinds of photos asked for so that everyone understands. Have the participants ever taken pictures like this before?

5. Send the participants outdoors and set a time for their return.

6. Upon the return of the students, discuss the photographs.

WINTER PHOTOGRAPHY

Winter can be harsh and deadly. But winter is also a time of serenity and beauty. Compose your own picture with your camera revealing nature's artistic touch.

Describe what you photographed. _____

_____

_____

_____

Dig down through the snow and clear away a six-inch square area of ground. Photograph what you see.

Was there evidence that nature is reawakening from her long winter's sleep? If so, what? _____

_____

_____

A forest is dynamic - constantly changing. Try to capture "change" on film. An example might be a plant recovering from a wound such as a lightning-struck tree. Possibly you might want to photograph an example of plant succession, or new growth of vegetation, or the many changes that snow brings to the forest.

What did you photograph and why? _____

_____

_____

Photograph something that arouses your curiosity, something you may not understand or may want to learn more about.

What did you photograph and why? _____

_____

_____

Discussion

1. Which photographs were easiest to take?

2. What pictures can be good without being beautiful?

3. What things do you usually take pictures of? Did you take any pictures that were unlike any you've ever taken (or seen) before?

4. Did you make any mistakes in your photographs - blurred images, too dark, too light? Can some of these mistakes work FOR your photograph?

5. What makes winter photography different from photography in other seasons?

NOTE: Please remember the following points when using the Polaroid cameras:

1. DO NOT toss away the film packet. It has been found that small animals eat this discarded material which contains a chemical that is deadly to wildlife.

2. If some of the developing chemical should get on your hands, wash the exposed area immediately in water or snow. If not done, the chemical can cause a skin burn.

3. Work as a team with your partner. Operating these cameras can be difficult, so help each other out.

4. Remember to keep the cold pack as warm as possible or your Polaroid print will not develop.

5. Be sure that either you or your partner has a watch. Remember: allow 90 seconds for your picture to develop inside the cold pack.

GROUP COMMUNICATION: MAKING A CREATIVE MOLD

In this activity each student will contribute one item to a flat sculpture which, when finished, will reflect the thoughts of the entire group.

Equipment

Center Provides	You Provide
Leaves	Clay, or you can make a mold in the sand at Flathorn Lake
Pine Cones	Plaster of Paris
Twigs	
Other items students pick up to put in the sculpture	

Procedure

1. Tell the group that they are going to make a sculpture that will represent their experiences at the Environmental Learning Center.

2. Ask each person to pick up one object that they feel is representative of the Center.

3. Flatten the clay or make a flat, shallow indentation in the sand. (The sand should be made to look like an empty, flat cake pan.)

4. Have the students arrange the objects in the clay or sand. If you use clay, you may press objects into the clay and remove them carefully so you have just an imprint. If you use sand, you will have to leave the object in the sand.

5. Cover the imprints (clay) or objects (sand) with plaster of paris.

6. When the plaster of paris is dry, carefully lift it from the sand or clay and examine the casting. Brush away any excess sand and remove all clay.

Discussion

1. Why did students choose objects that they did?

2. If they made a second sculpture, how would they change it? Why?

CREATIVE WRITING

Using things in nature to provide ideas for stories.

Equipment

Center Provides	You Provide
Clipboards	Paper
	Pencils

Procedure

Have the students write an imaginative story or legend on:

1. How the Poplar Tree Was Saved From the Forest Fire
   (You will find this tree in the burn area)

2. How the Pitcher Plant Got its Pitcher
   (Plants are located in the bog 100 feet south of dorm 3)

3. How the Bent Birch Got That Way

4. What Happened to Me When I Ate the Ultimate Pea at the ELC

5. Follow some tracks in the snow and tell a story about what happened to the animal that made them.

6. Find something weird in the forest and write about it.

7. Look for a cloud with an interesting shape or picture and write about it.

Make a display of the children's work in your dorm, in the classroom building or in the dining hall. Please consult an ELC staff person about available display sites.

Additional Procedure:

Have the students draw pictures of their stories.

WRITING A GROUP POEM

Equipment

Center Provides	You Provide
Clipboards	Note Paper
	Pencils

Procedure

1. Have the group decide on a topic for a poem. (It is best if this is a fairly broad topic, such as Nature.)

2. Have each person go outside and sit in a different location and write one phrase that conveys his feeling in that location.

3. After a specified time, have the students return to the starting location.

4. List the phrases and have the students arrange them into a poem.

Discussion

1. Did people write lots of different kinds of phrases, some humorous, some serious, etc.?

2. Was the resulting poem easy to read when it was finished?

3. How is a group poem better than individual poems? Worse than individual poems?

HAIKU

Haiku is a Japanese verse form that is noted for its simplicity. The first line has five syllables, the second has seven, and the third has five. A complete thought about an object or idea should be expressed by this seventeen-syllable structure.

Equipment

Center Provides	You Provide
Clipboards	Note Paper
	Pencil

Procedure

1. Make sure the students have a clear understanding of how to write haiku. Perhaps have them experiment in the classroom before coming to the ELC.

2. Have the students write haiku that conveys their thoughts or impressions of something that intrigues them.

CINQUAIN VERSE

Cinquain is a simple verse form of five lines. It is excellent for vocabulary work as well as for reviewing or learning the parts of speech.

Equipment

Center Provides	You Provide
Clipboards	Paper
	Pencil

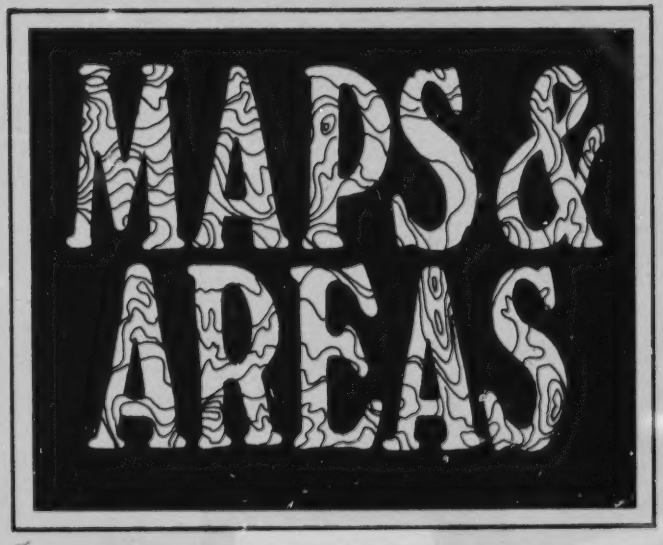
Procedure

It may be best to introduce cinquain in the classroom prior to your ELC visit. cinquain follows this form:

1. The first line is a noun that serves as the title of the verse.
2. The second line is two adjectives that enhance the noun.
3. The third line is three verbs that describe action of the noun.
4. The fourth line is four adverbs that enhance the verb.
5. The fifth line is a noun that descriptively restates the title.

A sample verse is:

Trees
Tall, straight
Swaying, bending, towering
Stately, majestically, quietly, softly
Pines



MAPS & AREAS

HOW BIG IS AN ACRE?

We read that a state or county has a given number of people per square mile, or per square acre, but we often have trouble visualizing this unless we have actually seen a well-defined square mile or acre.

Equipment

Center Provides	You Provide
Clipboards	Note Paper
100' Tape Measures (Optional)	Pencils

Procedure

1. Ask the students if they think they can mark the boundaries of an acre of land. You may have them do this near the dorms or on the baseball field west of the dorms.

2. After the students discuss what they think the size of an acre is, ask if anyone knows what the actual length and width of an acre is if it is square. NOTE: An acre has 43,560 square feet, and if square, each side is just over 208 feet.

3. Using the tape measure, or pacing, have the students mark off one acre. (One student can stand at each corner, or some other simple marking system can be used.)

4. Mark off acres that have other shapes.

Discussion

1. Do the students think that an acre is a big or a little piece of land?

2. Is an acre more or less land than they first thought?

3. If an acre of land costs $1,000, how much would it cost to purchase the field where you did the experiment?

4. Have the students stand within one acre. Do they feel crowded? How many students can be added to the acre before they feel crowded?

MAKING A MAP

This activity is designed to introduce students to the triangulation method of map making. The first maps that were produced with any degree of accuracy were done in this method.

Students will become acquainted with basic trigonometric concepts utilized in map making, as well as produce a map which can be used for recording data relative to the lake mapped.

Equipment

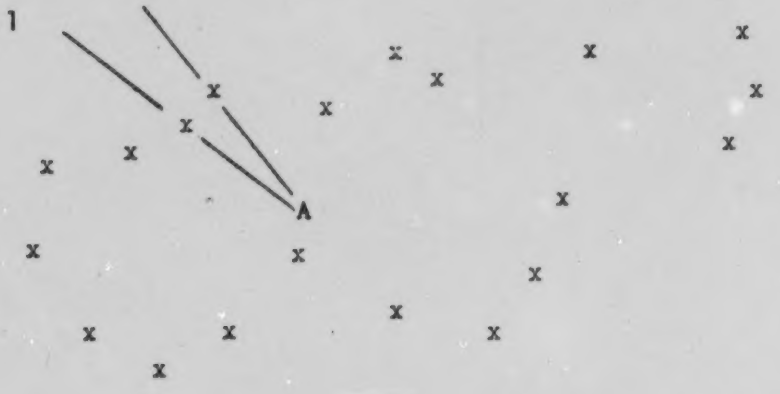
Center Provides	You Provide
Map Boards with Tripods	Pencils
Alidade Sighters	Paper
Compasses	Tape
Rulers	One Pin
100' Lengths of String	
Marker Flags	

Procedure

Students are to take equipment to one of the area lakes. Flathorn and Fishfry are the two which are most "mapable" due to the lack of bays and coves. The materials will be available in packages, with one of each necessary piece located in a packsack assigned to each team of students.

1. Instruct the students to place the orange flagged markers at prominent points around the lake. Extremes in the shore line should be the first to receive markers.

DIAGRAM 1



X = Designates orange marker flags

2. When the marker flags are placed, determine a point from which to make your first set of sightings. This shall be considered "Point A" and should be located in a spot where all or most of the markers can be seen. (See "A" on Diagram 1.) Using the adjusting mechanisms on the tripod, and the level located on the map board, make the board level.

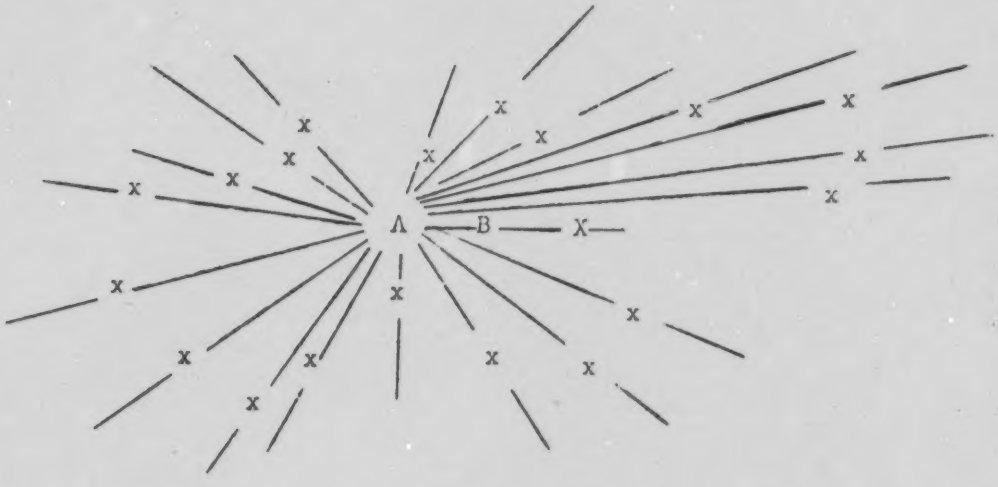
3. After the board is level, tape the map sheet included with the kit to the board and, with the compass, determine north, drawing a line to indicate the direction on the map sheet.

4. You are now ready to begin constructing your map. Stick the pin into the paper and board at a spot which corresponds to your location on the lake. This should be similar to "A" in Diagram 1. Center the alidade on the pin and sight through the alidade to one of the markers. When this is done, mark a dot with a pencil at the end of the alidade opposite the pin. Draw a line from the pin to the mark, and label the line 1A, and go on around the lake, shooting lines to each of the markers, until all are done. (See Diagrams 1 and 11.)

5. When you have sighted all of the visible markers on the lake, send a person off with one end of the 100' string while holding one end on the pin at "Point A". Be sure that the direction does not conflict with one of the sighting lines from "Point A".

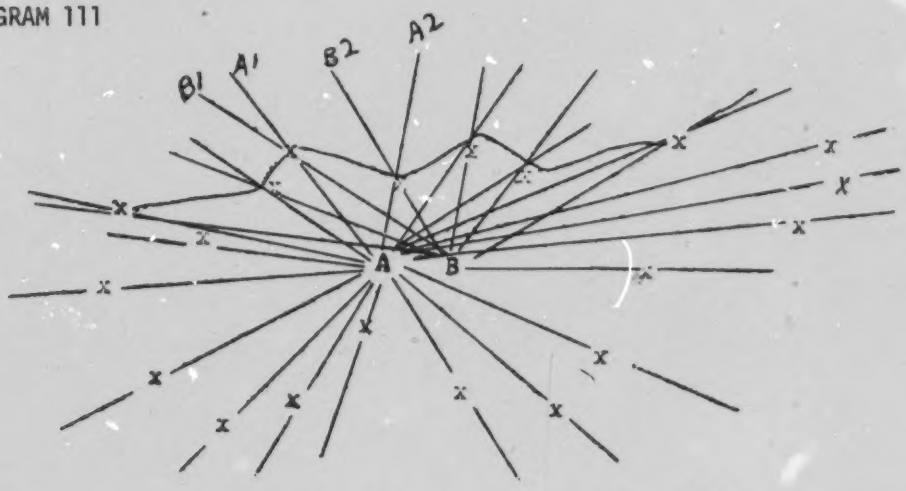
6. When 100' is reached, pull the string tight over the pin, sight with the alidade to the person holding the string and place an "X" on the map. Draw a line from "Point A" to "Point X". Measure one inch from "A" on the line, and label this "Point B". You will have determined your map scale to be 1" equaling 100'. See Diagram 11.

DIAGRAM 11



7. Now, sighting from "Point B", go through the same procedure again, drawing lines from "Point B" out to the markers. Your map will look like the map below when you have completed the top half of "B" sightings. BE SURE AND MARK ALL OF THE "B" LINES AS "B1", "B2" AND SO ON. DO THIS WITH "A" SIGHTINGS ALSO.

DIAGRAM 111



8. When "A" and "B" have been completed (it will not be nearly as crowded as Diagram 111) draw the shoreline of the lake through the points where "A1" and "B1" intersect, to the point where "A2" and "B2" intersect, and so on until the outline is completed. The northwest corner of the above lake is completed.

Upon completion, the finished map may be used for recording data gathered about the lake or about the land around the lake. Ask the students where, or how else, this triangulation method could be used.

DETERMINING CHARACTERISTICS OF THE LITTLE ISABELLA RIVER FROM A MAP

The Little Isabella River is one of two main tributaries to Flathorn Lake. The headwaters of this stream begin to the east, near the town of Isabella. The Little Isabella is typical of the region as it begins in a bog area, meanders slowly through the lowlands, and terminates in a lake-chain system. This river and lake system drains into Lake Superior. If one were to traverse the length of the Little Isabella, a variety of vegetation would be seen.

Equipment

Center Provides	You Provide
Isabella Quadrangle Maps	Pencils
Clipboards	Notepaper or Activity Cards

Procedure

1. Divide each group into teams. Give each team a map and Activity Card A. Allow the groups about 20 minutes to complete the activity. Assist with suggestions only after 10 minutes of investigation and if it is apparent that the group is not getting anywhere.

2. When the teams have completed Activity A, bring them back together as a group. Using a blackboard or chart paper, write down all of their observations and inferences. Permit time for discussion of each.

3. If you are to terminate your river studies with this activity, summarize the types of things that can be learned from a topo sheet. If you are going to do another river activity, use those observations and inferences to prepare the students for the next experience.

DETERMINING CHARACTERISTICS OF THE LITTLE ISABELLA RIVER FROM A MAP

ACTIVITY A: Look at the map of the Little Isabella River. Write down everything you can tell about the river just by looking at the map. These are things you can observe just by looking at the map. Write in as "observation".

OBSERVATIONS

The second part of this task involves inference. An inference is something you know from past experience. You probably saw the river when you arrived in camp. You know what many characteristics of the area are. Write down as many things as you can which you can't tell by looking at the map, but which you can infer because of knowledge you already have. One is done.

INFERENCES
There are probably trout in the river.

MAPPING THE CROSS SECTION OF A STREAM

A profile of the Little Isabella River, or other stream, may help you discuss temperature, velocity, and types of aquatic life in the stream.

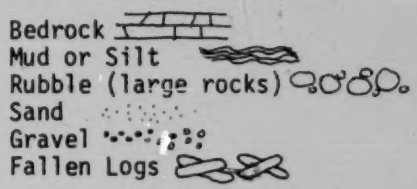
Equipment

Center Provides	You Provide
Meter Sticks	String (About 50 ft.)
Clipboards	Pencils
	Paper

Procedure

1. Securely suspend a string across the stream.

2. At regular intervals, such as every 6 inches, record the depth of the water, type of bottom material and type of vegetation. Possible symbols for recording bottom type are:



3. When the data has been obtained, use a smaller scale to record the data in your notebook.

Discussion

1. Why is it necessary to make your measurements at regular intervals?

2. Do you think the bottom of the stream will change in the future?

Adapted from: William A. Andrews (ed) A Guide to the Study of Freshwater Ecology, Prentice-Hall, Inc. Englewood Cliffs, N.J. 1974

STUDYING AND MAPPING A ROCK

Rocks often have mosses, lichens and even trees growing on them. At the ELC it is possible to find many large rocks suited for this study near the trail that goes around Flathorn Lake. Perhaps the two best locations for this are the far side (north) of Flathorn Lake and near the outlet of Flathorn.

Equipment

Center Provides	You Provide
Trowels	Note Paper
Soil Test Kit	Pencils
Plastic Collecting Jars	
Tape Measures	
Soil Thermometer	
Compass	
Clipboards	

Procedure

1. Observe the overall vegetation pattern on the rock. Put a north-south axis on your paper. Draw a map of the surface of the rock showing the location and shape of each major patch of vegetation.

2. If possible, identify the common vegetation on the rock. You may want to collect a few small samples to identify back at the Center. If you do this, on your map you may want to put "species A", "species B", etc., and label the samples the same way until they are identified. Use caution in collecting the samples; some of the lichen and mosses have taken hundreds of years to establish a footing on the rock, so please don't remove them all in one swoop.

3. Look for evidence of competition between species.

4. Look for evidence of symbiotic relationships between plants.

5. Examine the soil around the rock. Does it have the same pH as the soil on the rock?

6. Examine the soil on the rock where the species grow. (Again, please take a very small sample because it has taken years for the soil to build up on the rock.)

7. Look for invertebrates living on the rock and in the plants growing on the rock. Do they have a special niche on the rock?

Discussion

1. Is there one side of the rock that has more plant growth?

2. Does one side of the rock appear to have more moisture than the other?

3. Can you use your map, or a friend's map to make comparisons with other rocks and predictions of where you would find a certain kind of plant growing?

4. Is there any way to determine how long the plants have been growing on the rock? Why or why not?

Adapted from: William A. Andrews (ed) A Guide to the Study of Terrestrial Ecology, Prentice Hall, Englewood Cliffs, N.J. 1974

INVESTIGATING AN ARM-CIRCLE OF THE EARTH'S SURFACE

Equipment

Center Provides	You Provide
Clipboards	Paper
Cameras (Polaroid Square Shooter 2)	Pencils, Markers or Other Media
Tape Recorders	Film

Procedure

1. Tell the group they are going to look closely at small sections of the earth's surface.

2. Take the group for a walk along the "edges" of the ELC - along the edge of the cleared area, along the watery edges and the boggy edges. While you are walking, have the students look for a place where they would like to do their investigation. Encourage the students to choose a variety of sites but within a reasonably close area.

3. Have each student pick a location that is approximately 6 feet by 6 feet. This will be his study site for the remainder of the lesson.

4. Have everyone map his site. Prominent rocks, trees, flowers and other ground phenomenon should be included. An appropriate scale should be included. The maps can be simple or elaborate.

5. Have everyone catalogue different kinds of plants growing in the site. They should be adequately described in case a later positive identification is desired. Except in very barren areas, everyone should have at least five plants.

6. Try doing a cross-section of the site showing the height relationships of the plants that have been listed. Follow a scale to keep the cross-section accurate. If time permits, try another cross-section at right angles to the first. What do the cross-sections show better than the map does?

7. Did some people find many different kinds of plants? Were their places different from those where people found only a few varieties? In what way?

8. Did anything seem to be living in your area? Insects, shrews, mice, something bigger? Was there evidence (droppings, footprints) that an animal had been there? Why do you think he came through there?

9. What changes occurred in the site while you were there? Light? Wind? Things coming and going?

10. How did your presence change the site? Footprints? Moved objects? Something left behind? Frightened creatures? (Plants?) Did you help distribute seeds, create a more difficult environment for the growth of a living plant, make a new place for something to grow? Did you do anything to the site on purpose, or were any changes you made accidental?

11. Is the site better or worse for your presence? Or just the same?

12. By now everyone should have seen something alive and moving in his area. Living creatures should be noted, possibly drawn, and their movements through the area charted on the map and/or cross-sections.

13. What is being heard at the site? Wind? Insects? Distant trees? Make a recording of the different sounds in your site. Try recording all the sounds during a three minute period, whether or not they seem important. They help to describe your area.

14. Have the participants spend a time at their site after they've recorded and mapped it. Have them watch for changes such as the wind moving the plants around, the entry or departure of small living things, etc.

15. If there is time, have everyone write a description or story about his site, imagination permitted. This might be done as a follow-up in the classroom.

16. Share the maps, charts and other material. Locate everyone's site on a map of the Center grounds. Who chose which site where?

Discussion

1. Is it easy or hard to select a site? What criteria do you use in site selection? What made the place you chose attractive to you in the first place? Did you like it better or worse after you got to know it? How do people choose places to do things, have things, be things?

2. Was your site a circle or a sphere? Did you dig into it a little? Did you think of overhanging trees and branches?

3. How did the sun and other weather affect your site while you were at it?

4. Did you notice where the shadows and sunny spots were on your site? What was the brightest place? What was the darkest?

5. Was there anything special about the lightest places and darkest places?

6. Were there lots of plants or just a few? Why do you suppose that was?

NOTE: This activity may become quite elaborate and is suitable for all age groups, depending on the analytic powers brought to it. Students who've done soil tests, insect identification and micro-climate studies can apply these and other experiments to their sites. A follow-up visit to the sites a day, week, month or year later could be valuable to demonstrate change and transition.

NOTE: Please remember the following points when using the Polaroid cameras:

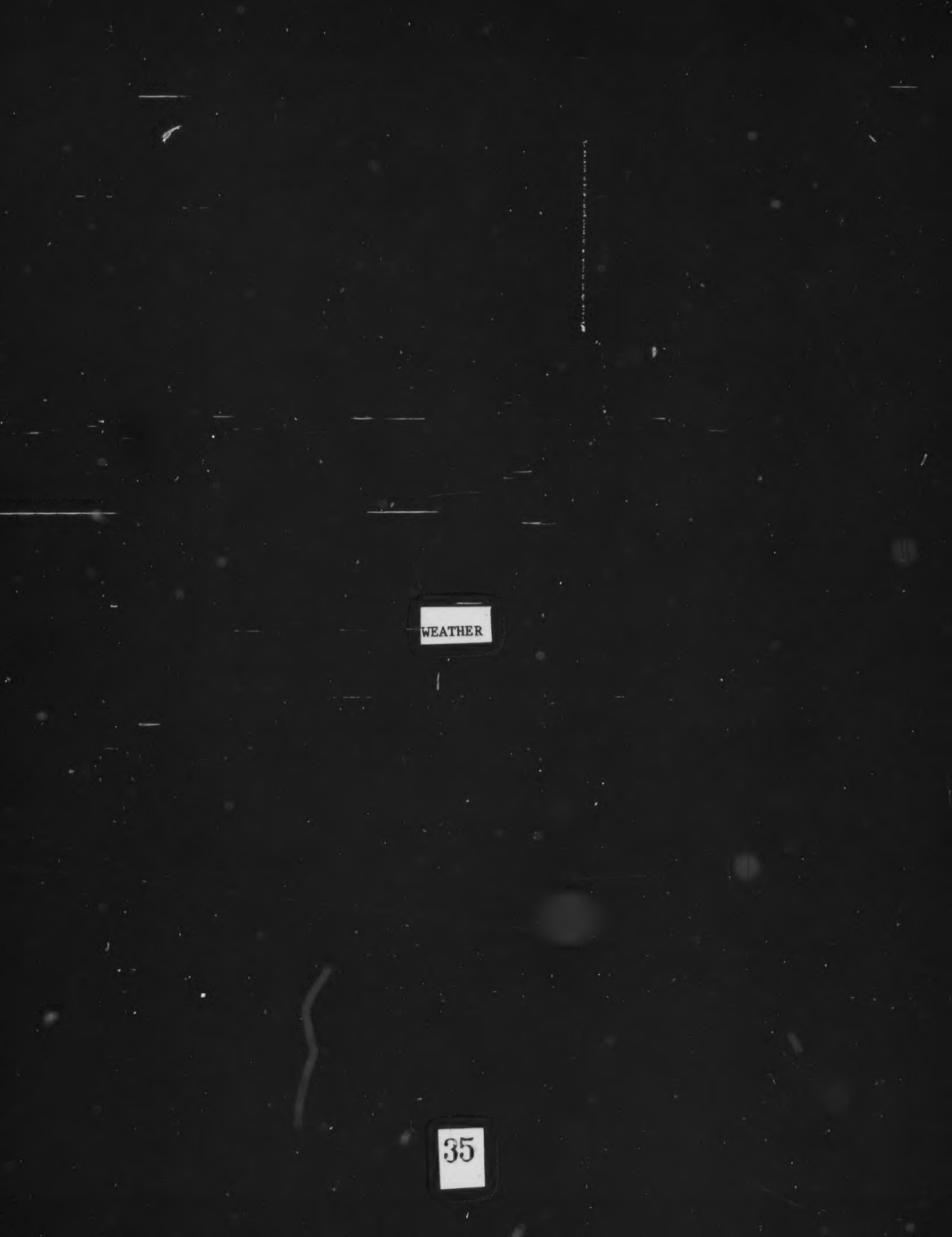
1. DO NOT toss away the film packet. It has been found that small animals eat this discarded material which contains a chemical that is deadly to wildlife.

2. If some of the developing chemical should get on your hands, wash the exposed area immediately in water or snow. If not done, the chemical can cause a skin burn.

3. Work as a team with your partner. Operating these cameras can be difficult, so help each other out.

4. REMEMBER to keep the cold pack as warm as possible, or your Polaroid print will not develop.

5. Be sure that either you or your partner has a watch. Remember: allow 90 seconds for your picture to develop inside the cold pack.


WEATHER
35

INCREASING AWARENESS OF WEATHER PHENOMENA

Equipment

Center Provides	You Provide
Clipboards	Unlined Paper
Cassette Tape Recorders	Writing and Drawing Tools
Thermometers (Optional)	Blindfolds

Procedure

1. Tell the students that they will be going outdoors to feel the weather and make a log of it using only their senses. Make sure everyone knows what a log is.

2. Once outdoors, blindfold the individuals and lead them to various points around the education building. Put people in protected places, open places and near exhaust vents or anywhere they will notice different weather conditions.

3. Give everyone a short time to sort out his impressions, asking each one to notice the heat or cold he feels, the wind direction and the moisture in the air.

4. Circulate among the participants and record their impressions with the cassette recorder.

5. Return indoors and listen to some of the observations. How did different people perceive the weather?

Discussion

1. What different weather phenomena affect people most? Temperature? Precipitation?

2. What weather events do people most remember in their lives? Are severe weather forms most memorable?

3. Are the participants conscious of the "weather" created indoors by man? Is this properly called weather, or should it be called something else? Does anyone notice the indoor weather very much?

4. How conscious of their environment (i.e. nearby walls, ground cover, etc.) were the blindfolded participants? How did their positions affect their observations?

5. What is a "nice" day? A "nasty" day?

CLOUD OBSERVATION (DRAWING)

Equipment

Center Provides	You Provide
Clipboards	Drawing Media (Many Colors But Not Black, White or Gray) Paper

Procedure

1. Select a day with clouds. Totally overcast days, foggy days and days with only thin wisps of clouds are most challenging. Fluffy cumulus clouds are just too easy.

2. Provide students with paper and a variety of drawing media. Withhold gray, black and white media to encourage closer color observation.

3. Go outdoors to an area where the students can comfortably sit and see a good deal of sky.

4. Have each person select a cloud and draw it. Ask them to make their pictures tell a story. They could show the movement of the cloud, the changes it goes through and so on. Arrows, overlaps and cartoon-type panels are possible devices to show the cloud actions but each person should be allowed to discover his own method of describing the changes.

5. If some finish early, have them draw the sky (cloud) that is in the place where they saw the first cloud they drew. They might also develop short stories about their clouds.

6. When everyone is done and satisfied with his drawing, compare the clouds to ones on a weather chart to find out just what kind they are.

7. Share the drawings.

Discussion

1. What is so hard about drawing clouds?

2. Which kinds of clouds are easiest to draw?

3. Were there many kinds of clouds to choose from or just one kind of cloud on this day? How are the different clouds distinguished from each other? Shape? Color? Height?

4. Were there different clouds moving in different directions? What does that seem to indicate?

5. Did the clouds seem to be increasing or decreasing while you were drawing?

6. Where did the cloud come from before it was drawn? Is it interacting with the clouds around it? With the land below it?

7. When have you seen clouds like this before? What kind of weather was there then?

LOGGING A STORM

Equipment

Center Provides	You Provide
Cameras (Polaroid Square Shooter 2)	Film
Clipboards	Paper
Thermometers	Pencils
Tape Recorders	

Procedure

1. Determine that a storm is coming. Falling barometer, thickening clouds and easterly winds indicate an approaching storm center. Listen for severe weather forecasts on the radio and TV. The best time for logging storms is from fall through mid-spring. It is during the colder months that storms are best organized, most predictable and last longest.

2. Determine what should be in the log. Things to include might be temperature, wind direction and speed, barometric pressure, sky cover, precipitation, visibility and any other phenomena the participants may want to include.

3. Determine when and how readings should be taken. Some readings may be taken from the Center's weather instruments; others should be gathered with the senses.

4. Make the recordings. Use a variety of media besides a simple chart. Try photographing the gathering clouds and falling precipitation to illustrate the chart. Tape record the rain or snow and wind through the forest. If you're logging a snowstorm, try photographing the rising depth of snow and growing drifts.

5. Try to note when precipitation begins and ends, when the wind shifts (E or NE to N or NW, especially) and changes in the direction of barometric pressure.

6. Arrange for continued logging after hours.

7. If a peak in the storm is sensed, participants should all go outside and experience it. Many people have not felt the full force of severe weather against their bodies.

8. When the storm is over, display and evaluate the data.

Discussion

1. Could a beginning and end of the storm be determined? With what criteria?

2. Compare the time of highest and lowest winds, lowest barometer readings, greatest precipitation and sudden temperature changes. Do these phenomena interrelate? How? Logging of additional storms may suggest patterns.

3. Will the logging of storms increase the participants' ability to forecast the activities of future storms? How?

4. How could you log a period of fair weather?

   Note: Of course it is impossible to schedule this activity; we just cannot guarantee a storm for you, but it is an excellent activity to have ready in case a storm appears while you are here.

Precaution: When using a Polaroid, please remember the following points:

1. DO NOT toss away the film packet. It has been found that small animals eat this discarded material which contains a chemical that is deadly to wildlife.

2. If some of the developing chemical should get on your hands, wash the exposed area immediately in water or snow. If not done, the chemical can cause a skin burn.

3. Work as a team with your partner. Operating these cameras can be difficult, so help each other out.

4. Remember to keep the cold pack as warm as possible, or your Polaroid print will not develop.

5. Be sure that either you or your partner has a watch. Remember: allow 90 seconds for your picture to develop inside the cold pack.

WINTER MICROCLIMATES

Most students are aware that at temperatures above 0°C (32F), precipitation falls in the form of rain and below that point it is snow. But what is the temperature of snow, the ground under the snow and the air in winter?

Equipment

Center Provides	You Provide
Thermometers	Note Paper
Clipboards	Pencils
Meter Sticks	

Procedure

1. In a sunny location, take the air temperature 25cm, 50cm, 75cm and one meter above the snow.

2. Take the temperature on the surface of the snow.

3. Take the temperature at regular intervals between the surface of the snow and the ground.

4. Take the ground temperature.

5. If possible, take the temperature a few cm below ground.

Precautions: Ask the students how they can take the temperature below the snow without disturbing that location and causing a resultant change in temperature. They should make as small a hole as possible to place the thermometer in and try to keep the sensitive area of the thermometer in the shade. Perhaps they can dig a small hole and then insert the thermometer into the snow in the side of the hole.

Discussion

1. Where was the temperature the warmest?

2. Where was the temperature the coolest?

3. What was the average temperature?

4. Why do you think the temperature was warmer or cooler in the snow?

5. How do you think the temperature variations under the snow affect plant and animal life?

SNOW

OBSERVING THE SNOW ENVIRONMENT

Snow effects different things in different ways. Walking through the snow can be a joy, especially if the walk is unhurried and time is taken to observe the snow in many different locations. This activity is a good one to combine with an orientation to the Center.

Equipment

Center Provides	You Provide
Clipboards	Pencils
	Note Paper

Procedure

As you show your students around the Center and Flathorn Lake to acquaint them with the area they will be studying the next few days, the following questions may help them sharpen their observation skills and set the mood for the week.

1. What did you notice about the snow around the base of large trees?
2. Does the snow appear to be the same depth everywhere?
3. What trees have been affected most by the snow?
4. What trees have been affected least by the snow?
5. What effect has the snow had on the lake? On the stream?
6. Which way did the last snowfall come from?

NOTE: Other activities that relate to this are: Observing and recording animal habits; measuring and recording snow characteristics; verifying predictions; determining the water content of snow; communicating feelings; awareness and values about snow.

EXAMINING SNOWFLAKES

Each snowflake has a different shape. Some are circular, some are star-shaped, some are conical and some are round. This activity is designed to get students to examine several snowflakes carefully to determine how many different shapes they can find.

Equipment

Center Provides	You Provide
Clipboards	Black Construction Paper
Hand Lenses	Pencils
Meter Sticks	Note Paper

Procedure

1. Shortly before the lesson begins, place the black construction paper outside so it will be cool.

2. Have each student place one or two snowflakes on his black paper. This may require the student to use his pencil point to tease the snowflake apart. Examine them with the hand lenses.

3. Have the students sketch the snowflakes or use some form of creative writing (such as haiku or cinquain) to describe the snowflakes.

4. How many different shapes of snowflakes did the students find?

Discussion

1. Why do the snowflakes have different shapes?

2. Were there different shapes at different depths in the snow?

Related Activities: HOW MANY SNOWFLAKES IN A DRIFT?

SNOWDRIFTS

Examining what is behind the formation of a snowdrift.

Background:

Snow depth and drifts are of concern to many people and organizations. The highway department tries to control the drifting of snow by constructing snow fences, thus making its snow removal job less difficult. The farmer knows that a heavy snow coverage is good for his soil because it keeps the ground from freezing to as great a depth as it would without the snow. The farmer's soil, therefore, remains more porous and can better receive and hold the moisture from melting snow and spring rains.

The effect of wind on snow can be related to the effect of wind on soil. Wind erosion of land takes place in a way similar to that of the formation of snowdrifts, but usually at a much slower rate. You may want to have the students relate their work with snow to the problem of wind erosion of soil.

Equipment

Center Provides	You Provide
Clipboards	Paper
	Pencils
	"Drift Barriers" (See instructions)

NOTE: The proper snow and wind conditions are important for this, so it is good to have an alternative lesson planned in case this cannot be carried out while you are at the Center.

Procedure

1. Explain to the students that they will attempt to create some snowdrifts that are miniatures of those caused by larger objects, such as buildings.

2. Select a flat area which is free of obstacles and barriers. The baseball field west of the dorms and Flathorn Lake are good sites.

3. Using objects of various shapes and sizes, the children will be able to create wind barriers. Have them insert their objects into the snow. If the object is heavy enough that it will not blow away, it can be placed on the surface. The only rule that must be followed is that the wind must do the work of moving the snow.

4. Have the students make a sketch of what they think their drift will look like.

NOTE: If the snow is light and dry, and there is some wind, the drifts will occur quickly and dramatically. If the snow is wet and heavy, the drifts will occur more slowly and be less evident.

Discussion

1. When the drifts have begun to form ask:

   a. Who had a long drift? Why?
   b. Who had a wide drift? Why?
   c. Did any drift dig a hole in the snow? Why?
   d. Were some drifts deeper than others? Why?
   e. Who had a tiny drift? Why?
   f. What happens when the wind blows around something with no corners?
   g. What happens when the wind blows around something with sharp corners?
   h. Do the students' sketches look like their drifts? Why or why not?

2. What happens to the drift when the object that causes it is removed?

3. Where does a drift end?

4. Did any of the drifts change shape after they began to form?

Additional Items:

These all use a team of students as opposed to individual or groups of students.

1. Create a very long drift.

2. Create a very wide drift.

3. Make the wind dig a deep hole in the snow.

4. Create a very high drift.

5. Create a great number of different shaped drifts using the same object for each.

6. Create a series of "mystery drifts". Have the other students try to quess what object was used to form the drift.

7. Create "drift art" by causing drifts to form in a pleasing way.

Please make sure the students take their "drift barriers" with them when the activity is over.

You may want to end this activity by reading the first three stanzas of John Greenleaf Whittier's "Snowbound" to the class.

Adapted from: Minnesota Environmental Science Foundation Unit "Snow and Ice", Minneapolis, Minnesota.

HOW MANY SNOWFLAKES IN A DRIFT?

Snowflakes are pretty small, but we usually see them in piles, drifts, and other locations that make them look like one large object.

Equipment

Center Provides	You Provide
Meter Sticks	Note Paper
Clipboards	Pencils
Hand Lenses	

Procedure

1. Put a little snow on your paper and separate it until you can see the individual flakes.

2. Measure each flake (about 6). What is the average size (length)?

3. Can you determine the thickness of the snowflakes? (Perhaps the students can pile up individual flakes and count them as they pile them and then measure the height of the pile and divide by the number of flakes in the pile.)

4. After the students have determined the average size of one snowflake, have them measure a small drift or pile of snow. Then determine approximately how many snowflakes are needed to make that pile.

Discussion

1. As snowflakes are packed together, do they become smaller?

2. Is the snow looser or more compressed at the bottom of the drift? Would this affect your estimate?

NOTE: It might be easier if the students determine the number of snowflakes in one cubic inch of snow and then expand this figure to meet the volume of the snow drift. But perhaps you want your students to discover this. Let them work on the problem; they may come up with a better way.

CHEMICAL COMPOSITION OF SNOW

Because snow is a form of water, it can be melted and then subjected to most of the same tests that are done with water.

Equipment

Center Provides	You Provide
Water Sampling (Hach) Kits, to include:	Note Paper
Carbon Dioxide	Pencils
pH	
Ammonia	
Dissolved Oxygen	
Nitrate Hardness	
Acidity	
Clipboards	
Cans to melt snow in	

NOTE: This lesson may be done inside if the snow is collected shortly before the lesson is to begin so it can be melted and the snow (water) is available. This might therefore be a good backup lesson in case there is a day of severe cold or blowing snow with a low wind chill factor.

Procedure

1. From 3 or more locations, collect snow in the cans and let it melt.

2. Conduct the chemical tests on the melted snow accordingly to the directions attached to each Hach kit (water sampling kit).

3. For comparison you may also want to conduct the same tests on tap water from the dorm you are staying in or take a water sample from the lake (an ice auger will be needed for this) and make a comparison.

NOTE: Dissolved oxygen content will change with a change in temperature, so it is best to conduct the tests as soon as the snow melts.

Discussion

1. Is there a difference in the chemical composition of snow and the other water you sampled? Why?

2. If you obtained snow from the top and bottom of a drift, was there a difference in the composition? Why?

SOIL

SOIL SAMPLING

Different plants require different soils for strong, vigorous growth. While most of the area surrounding the ELC is mixed hardwood-coniferous forest, there are some areas of one distinct vegetation type where students may find a difference in soil type. To help see a difference, it is recommended that you take samples from the baseball field west of the dorms, from the area around the dorms, from a wooded site with mixed vegetation and from a wooded site with one predominant vegetation type.

Equipment

Center Provides	You Provide
Soil Samplers	Pencils
LaMott pH Kit	Paper
Clipboards	Optional: Glue
Plastic Cups	Stiff Paper or
Hand Lenses	Poster Board

Procedure

1. With the soil auger, take a sample and put the top portion in one plastic cup, the central portion in another and the bottom in a third. If you wish to go deeper, you may reinsert the soil sampler in the same hole.

2. Check each sample for pH.

3. Record the vegetation growing in the area where your sample was collected.

4. Be sure to label each sample so you will know where it was obtained and from what depth it came.

Discussion

1. Did the pH vary? Why?

2. Does the soil color vary from location to location?

3. Does the soil color vary from the top to bottom of a sample?

4. Does the soil texture vary?

5. Glue the samples of soil to poster board to show the differences in color and texture from top to bottom of your samples. You may want to note on the board the pH of each sample also.

SOIL PERCOLATION

The ability of a soil to hold water or let water drain through it affects the plants that grow in that location. A soil that is well drained will have vegetation different from one that is not. The following experiment should begin to show students that not all soils allow water to pass through them at the same rate.

Equipment

Center Provides	You Provide
Cans of the same size with both ends cut out	Paper
Water Container of known amount	Pencils
Clipboards	Watch with second hand (if no stop watch is available)
Stop Watch	

Procedure

1. Put each can into the ground the same distance, approximately one to 1.5 inches (2.5 - 4cm).

2. Fill each can with a known amount of water.

3. Determine how long it takes for all the water to drain from the can into the soil. If the water comes up outside of the can, it is not in the soil straight enough nor far enough.

4. Repeat this in several locations. Try the soil around the Center buildings, a wooded area, quite close to the stream, the beach and other spots the students may suggest.

Discussion

1. Why did the water drain faster in some locations than others?

2. Where did it drain fastest?

3. Where did it drain slowest?

4. Did the students observe any clues that might help them determine how well the soil would drain before trying the experiment, such as vegetation cover, soil particle size or other factors?

AQUATICS *

CHEMICAL COMPOSITION OF WATER

Equipment

Center Provides	You Provide
Water Chemistry Kits Including: Oxygen Kits Carbon Dioxide Kits Nitrogen Kits Clipboards	Note Cards or Activity Cards Pencils

Procedure

1. Divide the students into four teams. Ask each team to complete Activity A. Activity A involves writing a definition for air and water. Assist the teams in listing the basic chemical composition of air and water.

2. When the students have listed the three main components of air and water, give them Activity Card B. Activity B involves completing a diagram to explain how elements are cycled through the environment. The participants are expected to draw arrows indicating that the plants' energy source is the sun, that the plants, during photosynthesis, take in carbon dioxide and release oxygen and that man takes in oxygen and releases carbon dioxide. You might rather work with the class, drawing the diagram on the blackboard.

3. Activity C instructs the students to conduct actual tests for CO_2, O_2 and N, first at the stream and then at the lake.

   The procedure is as follows:

   A. Teams one and two will first take a glass jar and obtain a sample of the river water. Ask them to estimate the amounts of oxygen, nitrogen and carbon dioxide in the water. Ask them to tell why they think it is there. While teams one and two are doing the estimates and related reasons, teams three and four will be conducting the tests. Instructions for the tests are inside each test kit.

   B. When teams three and four have completed their tests, take them all to the beach at Flathorn Lake and do the same activity with the river test teams doing the estimates and the river estimate teams doing the lake testing.

4. When the field work is completed, return to the classroom and record the estimates and the actual amounts. The normal range in Parts Per Million (PPM) for those items are: Oxygen 6-15 PPM; Nitrogen 40-80 PPM; Carbon Dioxide 10-30 PPM. Those three components comprise much less than 1% of water, with the major component being H_2O (99.4%). Oxygen, nitrogen and carbon dioxide, are the primary components (99%+) of our atmosphere.

5. Have the students re-define air and water verbally or on the back of their first activity card. An evaluation of the effectiveness of the session may be gained by comparing definitions.

CHEMICAL COMPOSITION OF WATER

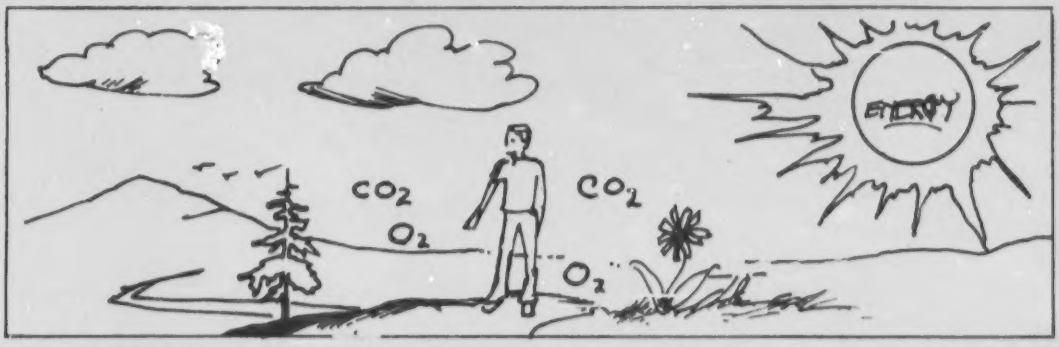
Activity A:

Describe air and what it is composed of:

Describe water and what it is composed of:

Activity B:

Complete this picture. Use arrows to show how animals and plants use and produce the different part of air. What role does the sun play?



Activity C:

When you have completed the discussion of Activity B, record estimates and reasons for the estimates of the amount of O_2, CO_2 and N that are contained in your water sample. Record test results in "Actual" column.

Estimates	Reasons	Actual
CO_2		
O_2		
N		

MINI-STREAMS

It is usually impossible to travel all the way from the headwaters to the mouth of a major stream to observe such features as gradient changes, waterfalls, piedmont and delta formation. However, with a little imagination and observation, all of these features can be observed in places where gully erosion is taking place.

Equipment

Center Provides	You Provide
Meter Sticks	Note Paper
Hand Lenses	Pencils
Clipboards	Sticks
Water Container	

Procedure

1. Find an area of gully erosion. There are several examples of this around Flathorn beach.
2. Determine where the most active erosion is.
3. Determine where the most active deposition is.
4. Carefully determine where the largest sand and gravel particles are being deposited.
5. Where are the smallest sand and gravel particles being deposited?
6. Push the stick 2 - 4 cm into the ground in the bottom of the gully and put a mark right at ground level. You may want to cut a notch in the sticks and then push them in up to the notch.
7. Slowly pour water in at the top of the gully and observe how much sand is removed or deposited at each marker.
8. Pour in more water, but this time pour it faster. What happens?

Discussion

1. Did more or less erosion occur when the water was poured faster?
2. Can students pick out in the gully the major areas of a river system, i.e., headwaters, piedmont and delta?
3. What could be done to stop this erosion?
4. Can streams be stopped? You may want to discuss the effects of a dam on a stream.

VELOCITY OF THE LITTLE ISABELLA RIVER

The velocity of a stream helps determine its dissolved oxygen content, carbon dioxide content, temperature and erosion capability.

Equipment

Center Provides	You Provide
Stop Watch	Pencils
Measuring Tape	Note Paper
Clipboards	Stick or Other Float
Hip Boots (Optional)	

Procedure

1. Measure a given distance in the stream. Try to pick a location that has no curves in it. A distance of 3 to 10 feet, (1 to 3 meters) should be sufficient. Please keep the tape measure dry.

2. Drop the float in the water and time its passage along the known distance. For the most accuracy, put the float in the center portion of the stream, upstream a little from the known distance.

3. Repeat step two several times and determine the average speed.

Discussion

1. With the time and distance measurements you know the velocity in either meters per second or feet per second.

2. If students measured the velocity in different locations, was it always the same? Why or why not? You may want to note the width and depth of the stream at the locations where velocity was measured.

MEASURING STREAM VOLUMES

It is useful to know the amount of water available in lakes and rivers, especially if that water is to serve some human need. In this activity the participants learn to compute the flow of water through Flathorn Lake by measuring the volumes of its two inlets and one outlet. With this information it is possible to determine how much water enters the lake through springs or is lost by evaporation.

Equipment

Center Provides	You Provide
Stop Watch	Paper
Tape Measure	Pencils
Clipboards	Stick or Other Float
Meter Stick	

Procedure

Determine the following values for Weiss Creek and the Little Isabella where it enters and leaves the lake.

1. (t) Time in seconds for the float to travel a measured section of the stream.

2. (l) Length in meters of the stream section.

3. (w) The average width in meters of the stream section.

4. (d) The average depth in meters of the stream section.

To compute the rate or volume of flow in cubic meters per second use this formula:

$$r = \frac{wdal}{t}$$

"A" is constant. The value of "a" is 0.8 if the stream bed is composed of rubble or gravel, and 0.9 if the stream bed is quite smooth (sand, mud, silt, bedrock).

If you have already measured the stream velocity in meters per second, use the formula:

$$r = wdav$$

Where "v" is the velocity of the stream.

If you have three or more groups of students, each one could determine the volume in a different activity period and after three periods you could then bring the groups together and discuss the inflow and outflow of Flathorn and possible springs or evaporation.

Discussion

1. If the average person requires 60 gallons of water per day for basic washing, cooking, drinking and toilet needs, how many people would the water in the Little Isabella River support? (NOTE: There are 264.17 gallons per cubic meter.) What other factors should be considered in determining the number of people that could be supported?

2. If you measure the volume of flow for the same stream in a wide section and a narrow section of the stream, will the two values differ? Why or why not?

3. If you measured the volume of water entering Flathorn Lake and leaving Flathorn Lake, was there a difference between the amount entering the lake and leaving the lake? Was water lost or gained in the lake? Why do you think this happened?

4. Do you think the measurements you made will be the same tomorrow, next week, next month, next year? Why or why not?

Adapted from: William A. Andrews (ed) A Guide to the Study of Freshwater Ecology, Prentice-Hall, Inc. Englewood Cliffs, N.J. 1974.

DETECTING AND DETERMINING ANIMAL ORGANISMS IN THE LITTLE ISABELLA RIVER

Most of the streams in the Isabella area and Superior National Forest have similar characteristics. One characteristic which is very noticeable is their reddish color. This is caused by the chemical tannin which is found in pine needles. When the needles fall into the water, or the run-off carries the tannin into the water, it becomes a reddish brown. This characteristic is especially noticeable in standing bogs, and the color is frequently referred to as "bog-stain".

Equipment

Center Provides	You Provide
Clipboards	Notepaper or Activity Cards
Invertebrate Keys	
Stream-screens	
Collecting Bags	
Hip Boots	

Procedure

1. Each team will complete two tasks. Activity A instructs them to observe the river and to write down any and all observable phenomena and related inferences which might lead them to believe that there is life in the stream. Then have them report the findings to the group.

2. Activity B consists of the examination of invertebrate organisms from the Little Isabella River. The teams will collect live specimens from the river. Specimens usually found in the Little Isabella River are the larvae of hellgrammites, stone fly, mayfly, dragonfly, caddis fly, midges, and other flies. These larvae stay in the river over winter and, when they are developed in the late spring, crawl from the water and hatch into a mature flying insect. The cycle is started again when the flying insect lays eggs on the water which hatch into larvae.

3. Each person should draw a picture of his specimen on Activity Card B. When completed, a comparison is made with the attached illustrations to determine which larva each team was working with.

4. The students are then asked to complete Part II of Activity B, which leads them to infer things about their larva based upon observation. The activity is complete when the group presents their findings and relates the larva's structure to its environment.

DETECTING AND DETERMINING ANIMAL ORGANISMS IN THE LITTLE ISABELLA RIVER

Activity A:

Write down as many observations as you can which you think would have something to do with whether or not there might be animal organisms living in this river.

For each observation, you are to write an inference. An inference is something that you know from past experience.

One observation and related inference is included on this card. Write down as many more as you can.

Observation	Inference
There are rocks in the river	Organisms could hide behind the rocks, live near them, and could be protected by them.

DETECTING AND DETERMINING ANIMAL ORGANISMS IN THE LITTLE ISABELLA RIVER

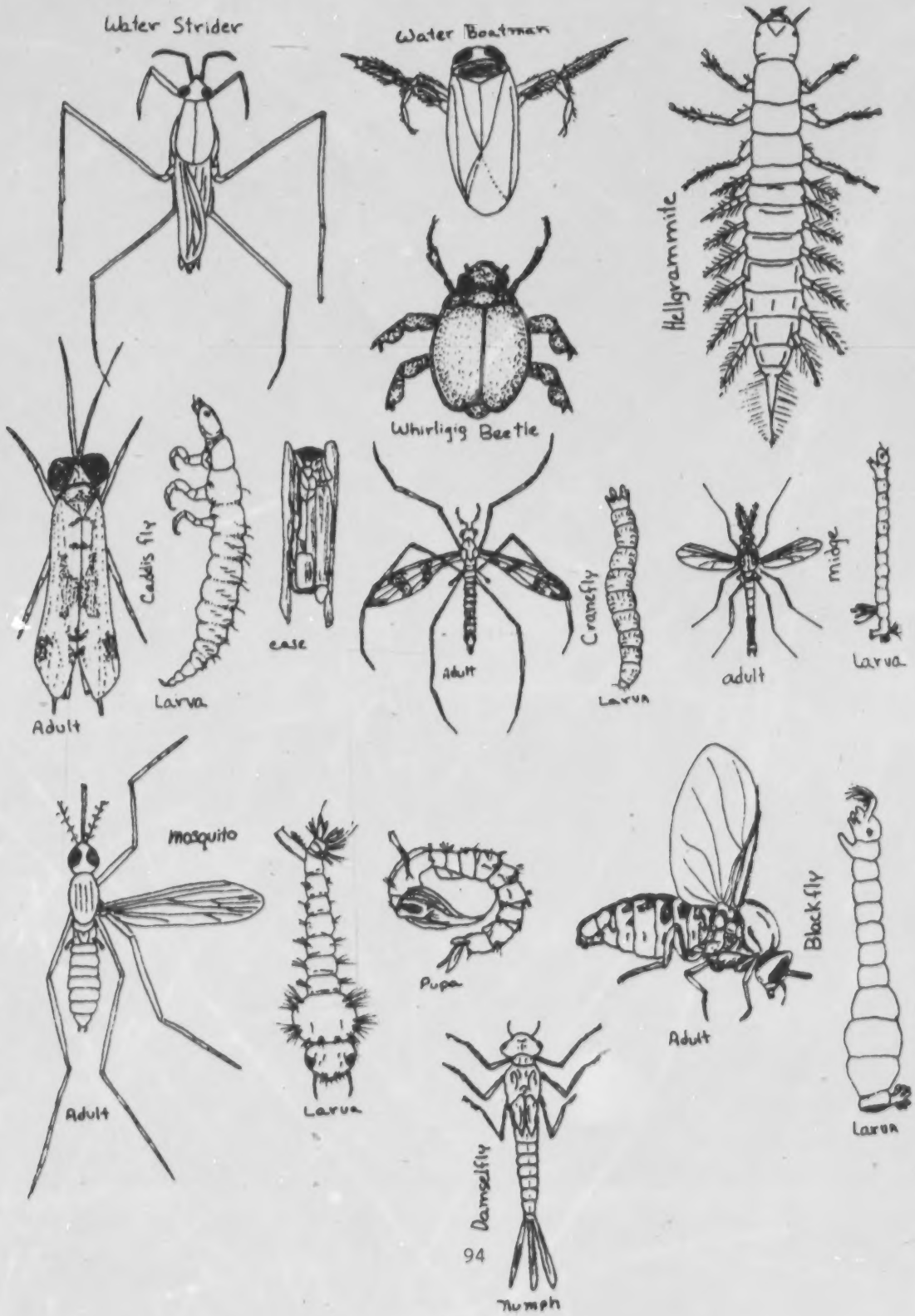
Activity B:

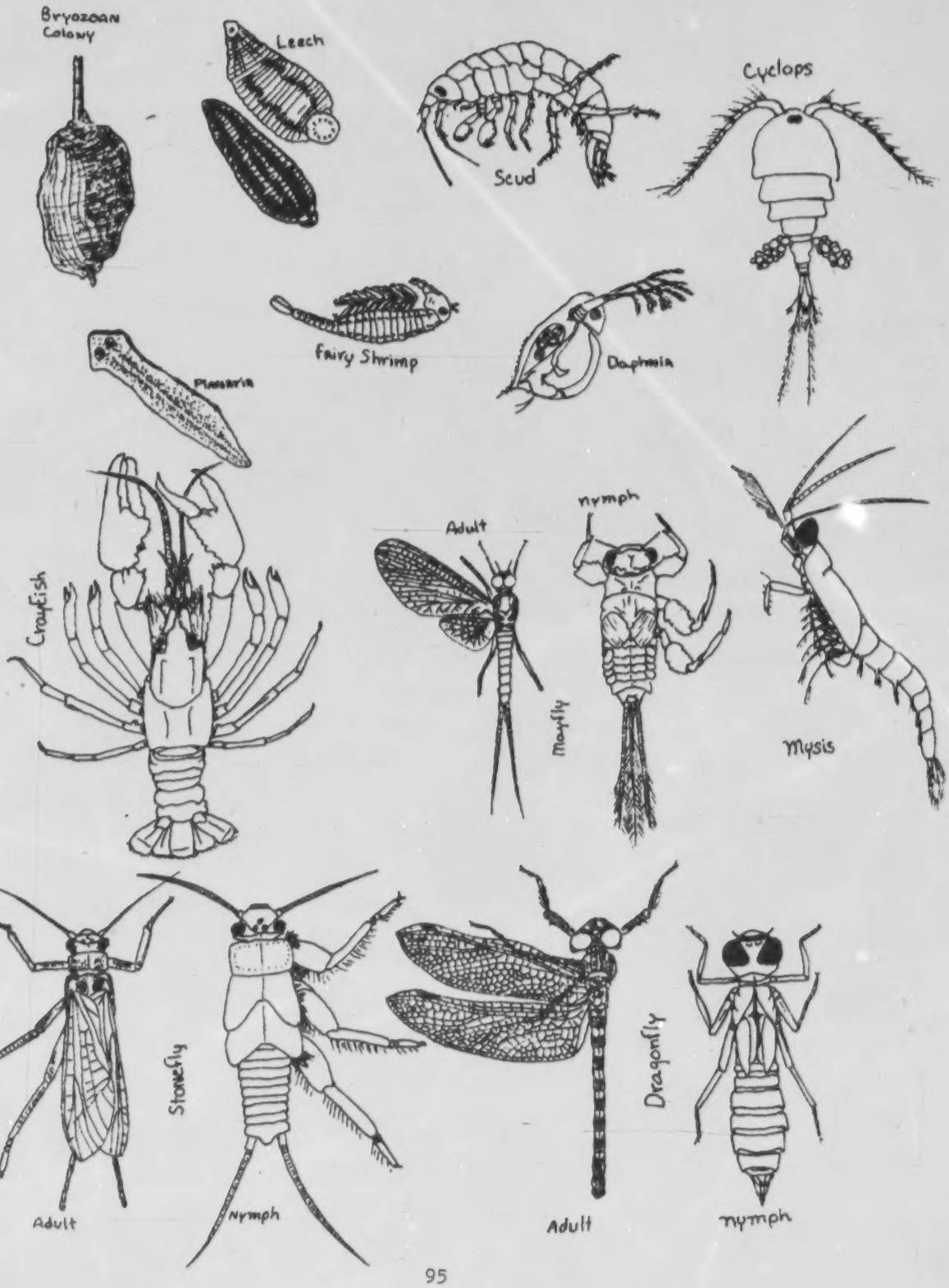
Part One: You are to draw a picture of the insect larva you have before you. Be very careful to include all of the parts as they are very important. When you have completed your drawings, the group leader will give you a chart, called a "key", which has pictures of insect larvae. Write the name of the larva most like yours under the picture.

This larva is a _____

Part Two: List all of the specialized parts of your larva under observations and indicate what might be inferred by the observation. One is done for you.

Observations	inferences
Hair-like gills	Used for breathing - for getting oxygen from the water.


Water Strider
Water Boatman
Hellgrammite
Whirligig Beetle
Caddis fly
case
Adult
Larva
Adult
Cranefly
Larva
adult
midge
Larva
mosquito
Adult
Larva
Pupa
Adult
Black fly
Larva
Damselfly
Nymph


Bryozoan Colony
Leech
Scud
Cyclops
Fairy Shrimp
Daphnia
Planaria
Crayfish
Adult
nymph
Mayfly
Mysis
Adult
Stonefly
Nymph
Adult
Dragonfly
nymph

TREES

DESCRIBING THE QUALITIES OF A TREE

Equipment

Center Provides	You Provide
Clipboards	Film
Cameras (Polaroid Square Shooter 2)	Pencils
Tape Recorders	Paper

Procedure

1. Take the group into the forest.

2. Tell everyone to be very conscious of the trees. It might be a good idea to ask for periods of silence as you approach the activity site in order for the participants to hear all the sounds of the trees and look at them more intently.

3. Gather at a site where there are lots of different trees. The forest west of the ELC cleared area might be one good place.

4. Have the group list tree qualities such a tallness, greenness, noisiness, etc. There should be as many qualities listed as there are students in the group.

5. Tell the students that each one must dramatize one of these qualities.

6. Give one quality to each student and let them each have a few minutes to prepare.

7. Ask the participants to either imitate the quality they must dramatize or poetically or musically describe the quality.

8. Each of the dramatizations should be recorded on camera and tape. Let the participants rehearse if they want to. The recording of the dramatizations may add to their significance.

9. Share the recordings with another group, especially one that has done or will be doing the same activity.

Discussion

1. What makes a tree different from everything else?

2. What makes a tree like everything else?

3. What tree qualities are easiest to describe?

4. What qualities are most difficult to dramatize?

5. When is a tree not a tree? Seedling? Seed? Stump? Fallen limb? Decayed log? Made into furniture? Kleenex? When does treeness end?

6. Who do you know that's like a tree?

7. Which tree is your favorite? What qualities make it so?

8. Are there any qualities you missed when you made your list?

9. Can you evaluate the dramatizations? Were some funny? Some sad? Some hard to figure out? Some bad?

10. Would it be possible for everyone to describe the same quality, each in a different way?

Precaution: For those with Polaroids, please remember the following points:

1. DO NOT toss away the film packet. It has been found that small animals eat this discarded material which contains a chemical that is deadly to wildlife.

2. If some of the developing chemical should get on your hands, wash the exposed area immediately in water or snow. If you don't, the chemical can cause a skin burn.

3. Work as a team with your partner. Operating these cameras can be difficult, so help each other out.

4. Remember to keep the cold pack as warm as possible, or your Polaroid print will not develop.

5. Be sure that either you or your partner has a watch. Remember, allow 90 seconds for your picture to develop inside the cold pack.

ACCURATE DESCRIPTION OF A SPECIFIC TREE (DRAWING)

Equipment

Center Provides	You Provide
Clipboards	Charcoal, Paint or Other Drawing Media Paper

Procedure

1. Select an area near the Center with a variety of trees. The area between the Little Isabella and the Flathorn Beach or the outlet of Flathorn Lake are good spots.

2. Have each person find a tree he would like to draw.

3. Have each person do a descriptive drawing of the tree. Things to include in the drawing would be the over-all shape of the tree, the direction of branch growth, the surrounding environment (other trees, rocks, plants, sky), the size and shape of needles and/or leaves, the placement of leaves on branches, the flowers and fruit and the roots, if visible.

4. A composite drawing might be suggested, one that shows details where necessary and that also includes the "big picture" of the tree.

5. Make sure the drawings show specific characteristics of the tree being drawn: a broken branch, a twisting root, etc.

6. Allow the persons to discover ways of making the picture more accurate. Tracing leaves will provide exact shape and size. Bark texture can be shown with a "rubbing". If some students finish early, have them draw their tree from different views: near and far, underneath it, maybe even from up in it.

7. Share the drawings, either on the spot or back in the classroom.

Discussion

1. What made the tree attractive to the artist?

2. Is it obvious what kind of tree is in the drawing?

3. How would it be possible to clarify or simplify confusing things in the drawings?

4. Check a book that identifies trees. How did the book's illustrator handle the problem of drawing a generalized tree of a specific species?

TREE CHARACTERISTICS RELATIVE TO IDENTIFICATION

Equipment

Center Provides	You Provide
Clipboards	Paper
	Pencils

Procedure

1. Divide the group into teams of three or so.
2. Have them list the trees they are familiar with.
3. For each tree listed, have them give three characteristics which help to identify it.
4. Set a time limit. See which group has the longest list and which group has the most descriptive characteristics when the time is up.
5. Have each group give the names and characteristics of the trees it has listed (take turns and don't duplicate kinds of trees).
6. Post the list on the board.

Discussion

1. What kinds of characteristics appear most often?
2. Are some characteristics more important than others in describing a tree?
3. How many and what kind of things do you need to know about a tree to be able to tell what kind it is?

This is a good activity to do shortly before your trip to the ELC. While at the ELC, the students can then compare some of the trees they discussed in the classroom with the trees they find at the Center.

USING A KEY TO IDENTIFY TREES IN THE VICINITY OF THE ELC

Equipment

Center Provides	You Provide
Clipboards	Keys (Reproduced from the Attached Ones) Note Paper or Activity Sheets Pencils

Procedure

1. Divide the groups into teams of 3 or 4.
2. Review the activity sheet with the group making sure everyone understands how to make note of the trees they encounter. This may seem confusing at first. Allow students to identify the tree by name if they are sure what kind it is.
3. Send the teams into the forest, setting boundaries and time limits. At least an hour should be allowed for this. All the trees common around the Center may be found between the Little Isabella River and the Flathorn Lake outlet bridge. A walk around the lake may be valuable, however, especially to encounter tamarack.
4. Give the teams the Tree Key upon their return.
5. Let the students determine how to use the key.
6. Have the teams positively identify the trees found on their hike.
7. List the trees found. Black ash, mountain maple and yellow birch are less common around the Center; they are not included on the key.
8. You may want to return to the forest with copies of the key, especially if the students had a great deal of trouble with one or two trees. As an alternative to this, you could collect a twig with needles or a representative leaf to use during the discussion at the end of the lesson.

Discussion

1. Which trees were easiest to identify?
2. What made those trees so easy to tell from the others?
3. What trees were hardest to identify?

4. How easy was it to identify the trees from the notes taken on the activity sheet? Can anyone suggest better ways to take notes on trees while in the field?

5. Could you apply this system of fieldwork to other areas and other kinds of plants?

6. What do you think is the best way to identify and remember new plants and animals?

Activity A:

Go into the forest and try to find eight different kinds of trees. Record their characteristics using the following key.

Habitat
1. Edge of field
2. Deep forest
3. Waters edge (20-30 feet)
4. High dry ground
5. Low, wet ground

Bark
1. Smooth with blisters
2. Smooth (old has stretch marks)
3. Smooth but peeling
4. Scaly
   a. Large 2" or more
   b. Small 1" or less
5. Deep groves
6. Color

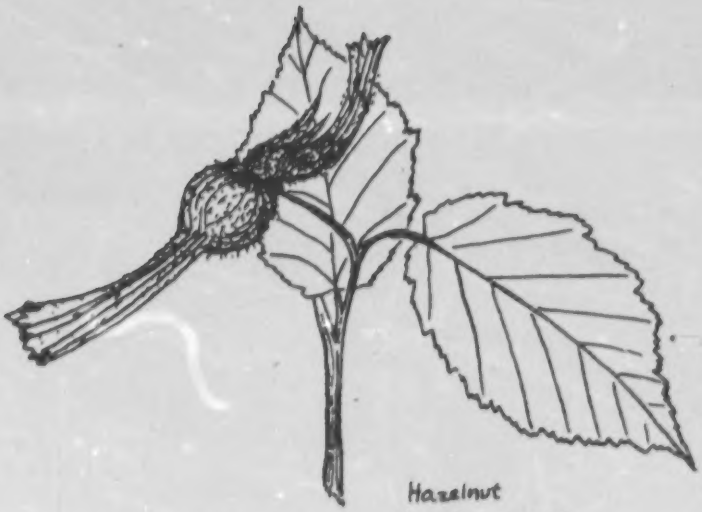
Leaves
1. Broadleaf
2. Needles
   a. single
   b. cluster
3. Shape
   a. flat
   b. triangular (will roll between fingers
   c. scales (like an alligator)
4. Length
   a. short-less than 5/8"
   b. medium-5/8" to 2"
   c. long-more than 2"

Other
List any distinctive shape, smell, color, fruit or cone. You may want to draw a picture on the back of this sheet.

HABITAT	LEAF	BARK	OTHER
1 - 4	1	3	White bark

KEY TO THE COMMON TREES AND SHRUBS OF THE ENVIRONMENTAL LEARNING CENTER

1a	Broadleaf	2
1b	Needle or Scale-like Leaf	5
2a	Tree	3
2b	Shrub	4
3a	Bark White & Peeling, leaves Irregularly Toothed	Paper Birch
3b	Bark Smooth in Young, Gray-green in color, furrowed in older trees, leaves with flattened petiole causes them to quake	Quaking Aspen
4a	Long thin twigs, bark smooth yellow brown, long skinny leaves	Willow
4b	Leaves irregularly tooth, bark gray produces a nut	Hazel
5a	Branches covered by many overlapping scale-like leaves	White Cedar
5b	Leaves are long thin needles arranged in groups or single	6
6a	Needles are single	7
6b	Needles are in groups	9
7a	Needles are flat and blunt, 3cm long, bark with resin blisters	Balsam Fir
7b	Needles shorter, 20mm or less with triangular shape	8
8a	Smaller tree, twigs turn black as they mature, needles 5-15mm long, grows in bogs and acid soil	Black Spruce
8b	Larger tree, twigs hairless, needles 8-20mm sharp, grows in uplands	White Spruce
9a	Needles in bunches of 5 or tufts	10
9b	Needles in bunches of 2	11
10a	Needles arise in tufts of more than 5, grows in bogs	Tamarak
10b	Needles arise in bunches of 5	White Pine
11a	Needles 2-5.5cm long, cones curved	Jack Pine
11b	Needles 8-15cm long, older bark forms large scales	Red Pine



Hazelnut
Corylus cornuta

A shrub 2-5m high, bark gray, young twigs with a few long hairs, these fall off as the twig ages; leaves oval, sharply and irregularly toothed, 5-13cm long, 3-5cm wide, petiole 1cm long. Produces edible seed; very common shrub in Northeastern Minnesota.

Paper Birch
Betula papyrifera

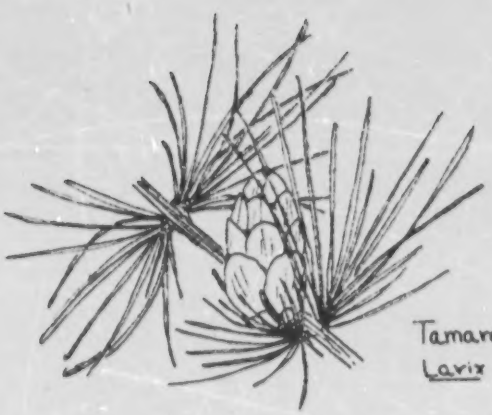
Large tree can reach a height of 25m and a trunk diameter of 50cm; bark white and peeling off in papery layers, in young trees the bark is redish brown; twigs slender; leaves ovate 4-8cm long, 3-5cm wide, double and irregularly toothed somewhat like hazel. Leaves may arise two at a time from a spur.

Quaking Aspen
Populus tremuloides

A straight slender tree 6-20m high and 20-60cm in diameter; bark smooth, greenish white or gray, becoming furrowed and dark on older trees; leaves hairless when mature 2.5-5cm long 2.3-5cm wide, lower surface paler, margin of slightly rounded small teeth; Pelioles as long as leaf blade, very slender and flattened. Both flowers in catkins; the beavers favorite food.

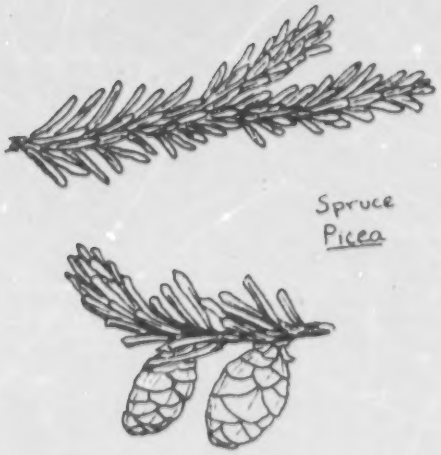
Willow
Salix candida

A shrub .5-2m high; twigs yellowish brown; leaves lanceolate; 4-12 cm long, 5-17mm wide, green above pale underside; male and female flowers catkins; common around the center.



Tamarack
Larix laricina

Trees with straight upright trunks 12-20m high, 30-50cm in diameter; bark rough scaly red brown; Needles 15-30mm long, soft and flexible, needles on tassle like tufts of many needles in a tuft, light green in summer turning yellow in autumn and falling from the trees; cones 1-2cm long; grows in bogs often with black spruce.



Spruce
Picea

Black Spruce: Usually a smaller tree 8-10m high with a straight trunk rarely over 30cm in diameter; bark scaly, dark gray-brown; twigs slender with tiny black hairs. Twigs are yellow brown when young, then with age turn black; needles are 5-15mm long, slender bluntly pointed and pleasantly aromatic in odor; cones 1.5-3.5cm long; grows in acid soils and bog conditions.

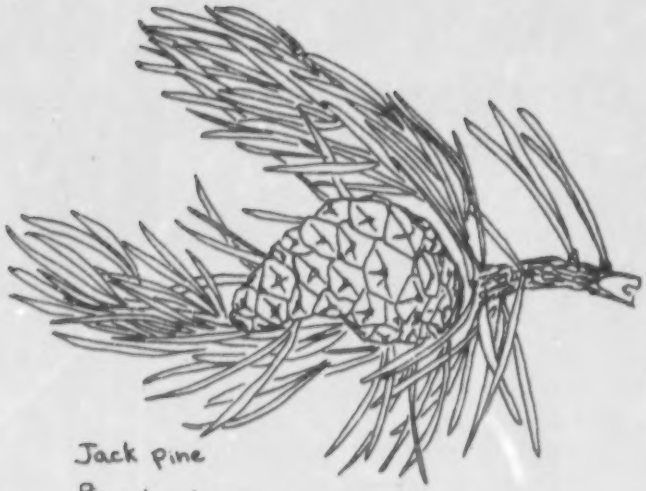
White Spruce: A large tree up to 30m high, with a straight trunk 30-60cm in diameter; bark scaly, light gray; twigs slender and hairless; needles 8-20mm long, slender, sharp pointed, blue green color and bad smelling when crushed. Cones 3-5cm long. The white spruce grows in upland forest areas.

White pine
Pinus strobus

Large tree to 40m tall and 1m in trunk diameter; bark of young trees smooth greenish gray. This becomes very thick gray-black and deeply grooved; needles in groups of five, when goung, needles are sorrounded by many scales but these fall off and this leaves them without a sheath. Needles slender and soft 7-10cm long. Cones 10-15cm long.

Balsam fir
Abies balsamea

This tree grows 15-20m high with a slender straight trunk 30-50cm in diameter and covered with resin containing blisters. Needles flat, blunt 1-3cm long, very fragrant; cones blueish green, 6-10cm long. Many of the balsams in this area are being attacked by spruce bud worm.



Jack pine

Pinus banksiana

Usually about 9-12m high sometimes taller. The trunk about 30cm in diameter, bark dark brown and irregularly divided into small scales; needles in pairs- each pair held at the base by a scaly sheath, needles flat and stiff 2-5.5cm long. Cones 5cm long- curved and pointing toward the end of the branches. These cones only open when exposed to heat such as that produced by a forest fire.

Red pine

Pinus resinosa

Red Pine is also known as Norway Pine. A large tree 24-30m high when mature. The trunk can be 60-100cm in diameter, bark redish brown, on older branches and trunk broad flat scales are formed; Needles in pairs, each pair sorrounded at the base by a papery sheath.

Needles are slender 8-15cm long and the Cone is about 5cm long.

77

White Cedar
Thuja occidentalis

Evergreen tree with straight or forked trunk 15-20m high and 1m trunk diameter; reddish brown fiberous bark on the branches, on old trunks forming loose scales, fragrant wood, and flat fragrant spray covered with small overlapping scale like leaves, leaves 3mm long, usually grows in wet situations but not in bogs.

Rosendahl, Carlotto....Trees and Shrubs of the Upper Midwest, University of minnesota Press, Minneapolis

Lakela, Olga.....A Flora of Northeastern Minnesota, University of Minn. Press, Minneapolis

Harlow, William A.....Fruit Key and Twig Key to Trees and Shrubs, Dover Publications, Inc., New York

Arimond, Sheila.....Key to trees of the Environmental Learning Center

Prepared by: Deborah Shubat, Environmental Learning Center, Isabella, Minnesota

DETERMINING THE AGE OF A TREE

Moisture, soil, sunlight and minerals affect tree growth. Trees of identical age and species may vary considerably in size due to variances in these factors. This activity is designed to have students learn about trees by determining their age.

Equipment

Center Provides	You Provide
Increment Borer	Note Paper
Diameter Tape	Pencils
Clipboards	
Hand Lenses	

Procedure

1. If the tree is large, use the increment borer to obtain a core sample and count the rings in the sample to determine the age. If you have not used an increment borer before, have an intern accompany your group to help you use the instrument.

2. If the tree is small and coniferous, you can usually determine the age by counting the whorls. Each whorl is one year. This method will also allow you to determine how high the tree grew in various years. This method fails when the bottom branches have fallen off. If there is one foot or more at the base with no branches, look for branch scars and be suspicious of your estimated age.

Discussion

1. How old is the tree?

2. Does a young tree grow faster than an old tree? Check the distance between rings or the distance between whorls.

3. In its first ten years, if a young tree, did it grow faster than you did?

4. What major event happened in the year the tree started to grow?

5. If you planted a tree today, what height would you expect it to be if you came back and saw it in ten years? Twenty years?

6. Do all kinds of trees grow at the same rate?

INTRASPECIFIC COMPETITION IN TREES

Intraspecific competition is the rivalry among members of the same species for light, minerals and water. If plants having identical requirements are growing close together, competition is inevitable. If the requirements are satisfied, the results of competition will not be too obvious. However, as the availability of light, minerals and water decreases, symptoms of overcrowding clearly show up.

Equipment

Center Provides	You Provide
Soil pH Kit and LaMott Handbook	Note Paper
Increment Borer	Pencils
Hand Lenses	
Clipboards	
Log Scaling Sticks	
Diameter Tape	

Procedure

1. Take the students to an area where there is one major species of tree growing. An intern may help direct you to a good study site.

2. Determine the height and diameter of the trees at the study site.

3. Determine the soil pH at the study site.

4. What is the average distance between trees at the site?

5. Determine the average age.

6. Are any nearby trees of the same species considerably taller or fatter than the rest of the trees? If so, carry out the following:

   A. Check the soil.
   B. Check the diameter.
   C. Check the age.
   D. Check the distance from other trees.

7. Look for signs that man has done some thinning around the trees.

Discussion

1. What differences were found in age, diameter, soil and height between the trees growing close together and the one growing by itself?

2. What other factors affect growth? Sunlight, moisture and other soil minerals are additional factors.

3. Is it possible to conclude that the trees would be larger if some were removed so the remaining ones would have more moisture, sunlight, minerals, etc.? Why or why not?

Classroom Follow-up: An experiment can be done in the classroom with bean, corn or other plant seeds placed in flats with various spacing to determine if there is an optimum spacing. Perhaps the students will be able to draw correlations between the classroom plants and the trees studied at the ELC.

The classroom plant lesson is detailed in: A Guide to the Study of Terrestrial Ecology, William A. Andrews (ed), Prentice Hall, Inc., Englewood Cliffs, N.J. 1974.

INFERRING CHANGES IN A STUMP OR FALLEN TREE

A fallen log or stump will usually amaze someone who looks at it closely for the first time. A frequent observation of a seemingly dead stump is that it is nuturing more organisms now than it did while it was alive. This observation is correct, as the log or stump very quickly becomes a nurse for a great variety of life.

A dead tree killed by the activities of the insects, animals and bacteria it has hosted is usually felled by a strong wind. The bark may be already off. The plants and animals that continue to inhabit the fallen tree change the wood both physically and chemically. The inside may be soft and spongy, while the outer shell remains firm. The opposite may also be true.

In time the log or stump will disintegrate and become a part of the forest soil. In the process of decomposing, it will have given life and shelter to a great variety of animal and plant life.

Equipment

Center Provides	You Provide
Clipboard	Drawing Paper
	Charcoal and/or Chalk

Procedure

1. Take the group to the Lake Gegoka end of the ELC nature trail. Instruct each student to find his own stump or log and to complete Activity Card A. Allow them 15-20 minutes.

2. Call the students back together and have each individual give one example of the things he recorded. It is important that each person be asked to contribute; a person who discovers something beautiful and exciting for the first time wants to share that discovery.

3. After the students have related their observations, instruct them to complete Activity B. This is done verbally by the instructor.

    A. Give each student a sheet of drawing paper and something to draw with.

    B. Instruct them to return to their log or stump and draw a picture of it. While they are drawing (give them about 5 minutes to get started) have them do the following (you may have to circulate about the area giving the following instructions):

(1) Write 2 descriptive words about the stump or log. (Words that tell what it looks like.)

(2) Write 3 action words about the stump or log. (Words that describe processes or changes taking place or things happening to it.)

(3) Write a short phrase, 4-5 words, that tells how the stump or log affects the rest of the environment. The phrase may describe its value or usefulness or any other thought you have about it.

(4) Write one word that sums up everything - a word that suggests a comparison, an analogy, or is a synonym.

(5) Give a title to what you have written.

4. When the above activities are completed, bring the students back together as a group. Congratulate them on writing a poem, and ask each to read his poem aloud.

ACTIVITY A

DO NOT TEAR THE STUMP OR LOG APART!

(15 - 20 minutes) Work by yourself.

What things are changing the log or stump now? Record the findings below:

Living Things	Effect on Stump or Log
Non-living Things	Effect on Stump or Log

What things about the stump or log give us clues about the past events that have taken place?

What factors caused these things to happen?

Why were you instructed not to tear the log or stump apart?

SUCCESSION IN A ROTTEN LOG

After a tree dies it passes through a number of well-defined stages before it decays completely and becomes part of the soil. Each stage is identified by a microcommunity consisting of characteristic organisms. When the organisms in one stage use up their food supply or in other ways make their habitat unsuitable for them, they are succeeded by other organisms. Thus a succession of communities occurs in a rotten log in much the same way that a succession of communities occurs in a vacant lot, abandoned field or even in a residential area.

Equipment

Center Provides	You Provide
Thermometers	Note Paper
Hand Lenses	Pencils
Clipboards	
Plastic Collecting Cups	

Procedure

1. Locate trees of the same species in the following stagesof succession:

   A dead tree still standing.
   A tree that has recently fallen.
   A tree (log) that has a rotten core and firm exterior.
   A tree with a rotten exterior and firm interior (if possible).
   A tree that is totally rotten.

NOTE: An intern can probably help you find these quite quickly, but you may want the students to do some hunting for the logs themselves.

2. Make measurements at the site to determine soil and air temperatures, soil condition (including color, moisture content and compaction), surrounding vegetation and other factors students may think are important.

3. Identify the surrounding plants that students may think are affecting the log.

4. Examine the standing tree for woodpecker holes, signs of bark beetles and other invertebrates, fungi, etc. You may want to collect some sample fungi or beetles to examine later in the classroom. Record the height of holes, fungi types, etc.

5. Examine the newly fallen log. Is the bark easier to peel off than from the standing tree? Compare mosses, fungi, lichens, etc. to those on the standing tree.

6. Examine each rotting log in a similar manner. Look for signs that salamanders, sow bugs, toads, or other animals and insects have been using the log as a home or feeding on the log. Do any of the logs have ants living in them? Do any have plants growing from them? Does each log have the same color, feel, texture, moisture? What other similarities and differences are found?

Discussion

1. Why was it important to examine the same species of tree in various stages?

2. Which organisms were most abundant in each stage?

3. Can you draw a food web for any of the logs?

4. Which stages had the greatest diversity of life? Why?

Precautions

The logs are homes of many organisms that are essential components of the forest ecosystem. Treat them gently.

Adapted from: William A. Andrews (ed) A Guide to the Study of Terrestrial Ecology, Prentice Hall, Englewood Cliffs, N.J. 1974

ANIMALS

FIND ANIMALS AND ANIMAL SIGNS

Equipment

Center Provides	You Provide
Clipboards	Activity Sheets
Optional Items:	Pencils
Binoculars	Optional Items:
Hand Lenses	Animal Identification
Live Traps	Books

Procedure

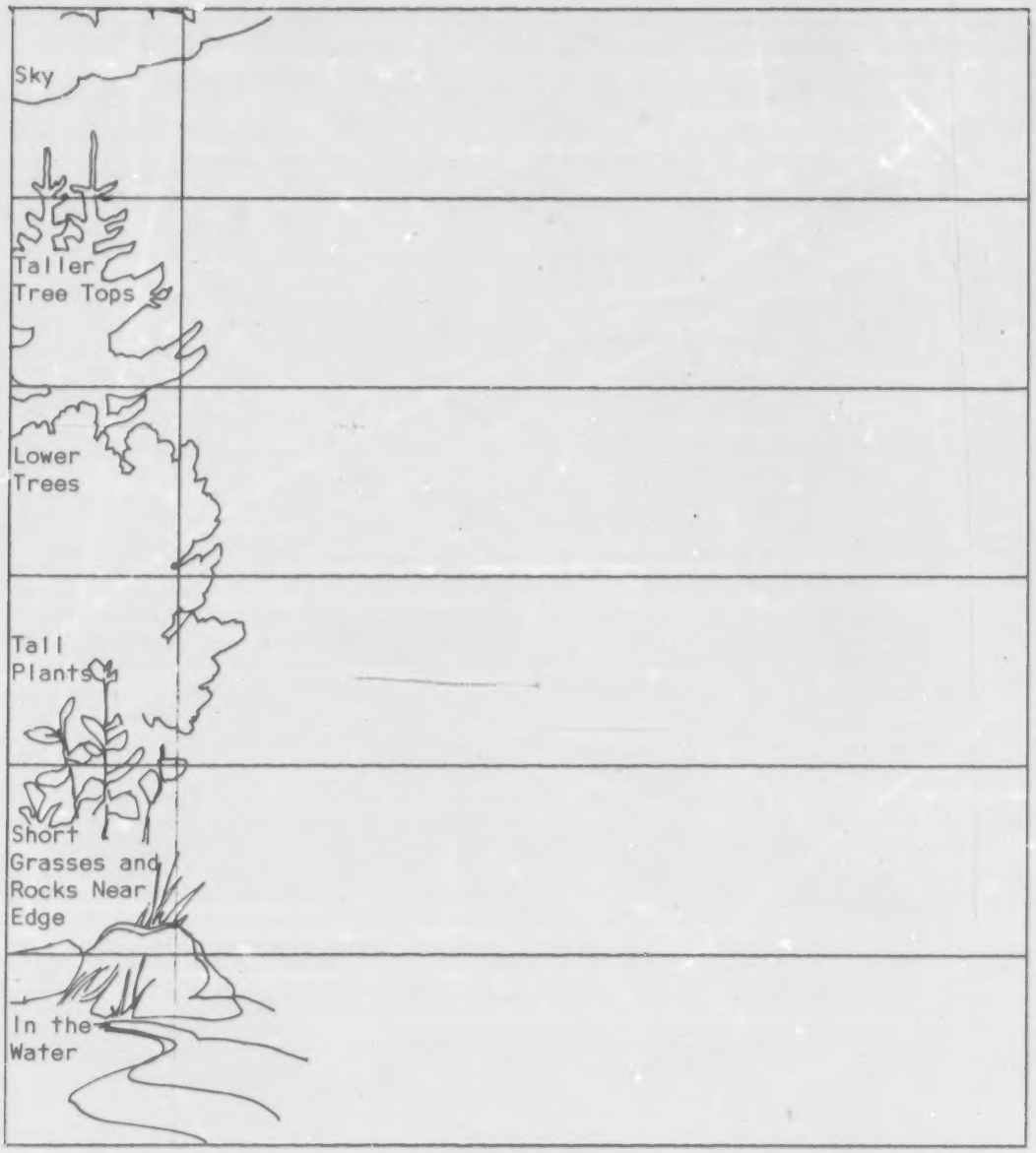
1. Discuss the signs that animals leave in an area, i.e., droppings, tracks, feathers, teeth marks, etc.
2. Explain that the students should be relatively quiet in one location for a few minutes if there is to be any chance to observe an animal.
3. Make sure students know the time and boundary limits for the lesson.
4. Encourage students to be sure to look for things that are big and little.
5. Ask students to record the animal's movements from one level to another.
6. Ask students to record what they see by name, drawing, or by a careful description.
7. Distribute the activity sheets, or have students make activity sheets on blank paper.
8. Have students use the activity sheets in the field.

Discussion

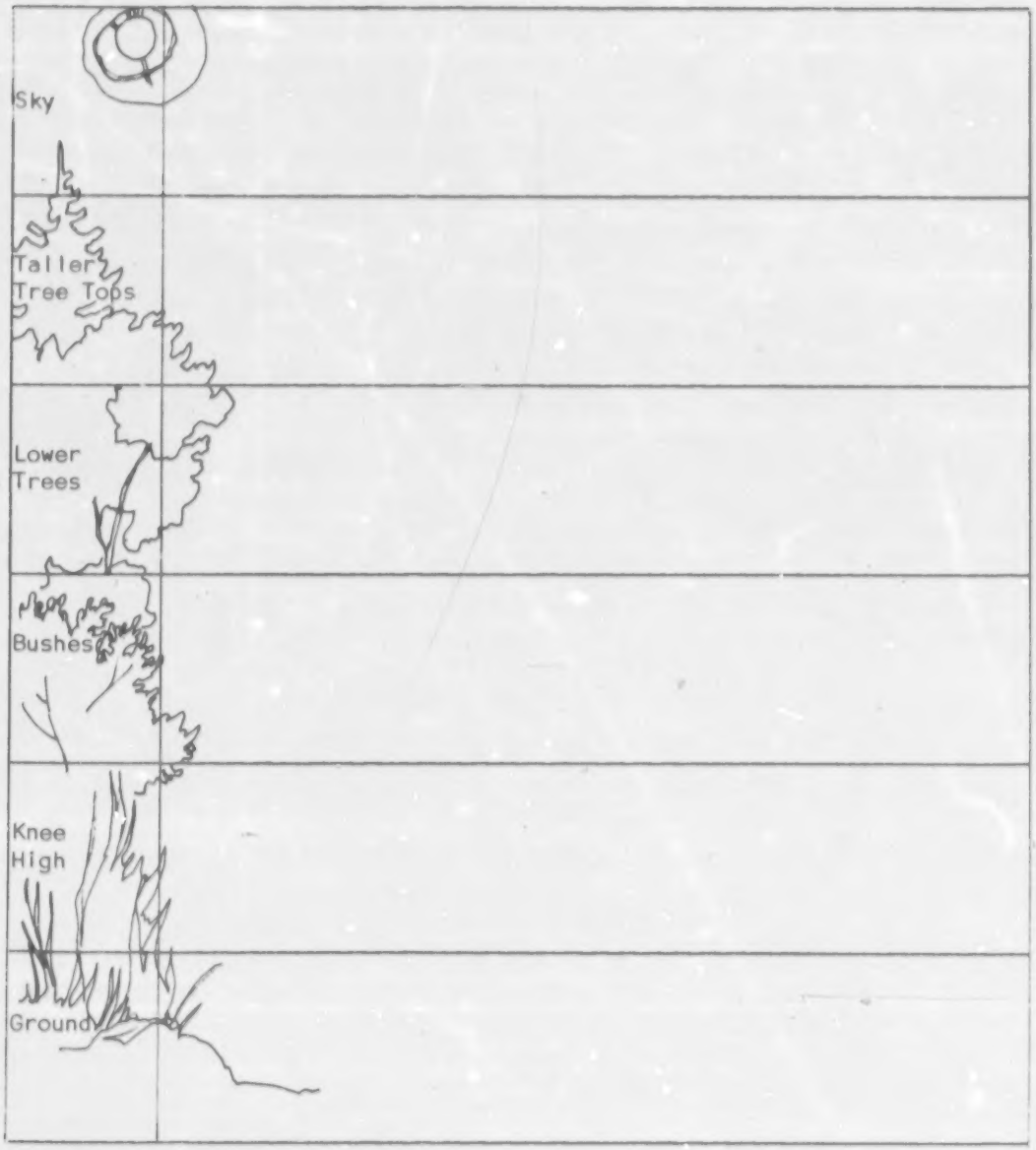
1. Do you think the time of day affected what you found?
2. Do you think the season affected what you found?
3. Do you think the weather affected what you found?
4. What other environmental factors may have affected what you saw?

Adapted from materials written by Nature Center, Hennepin County Park Reserve District.

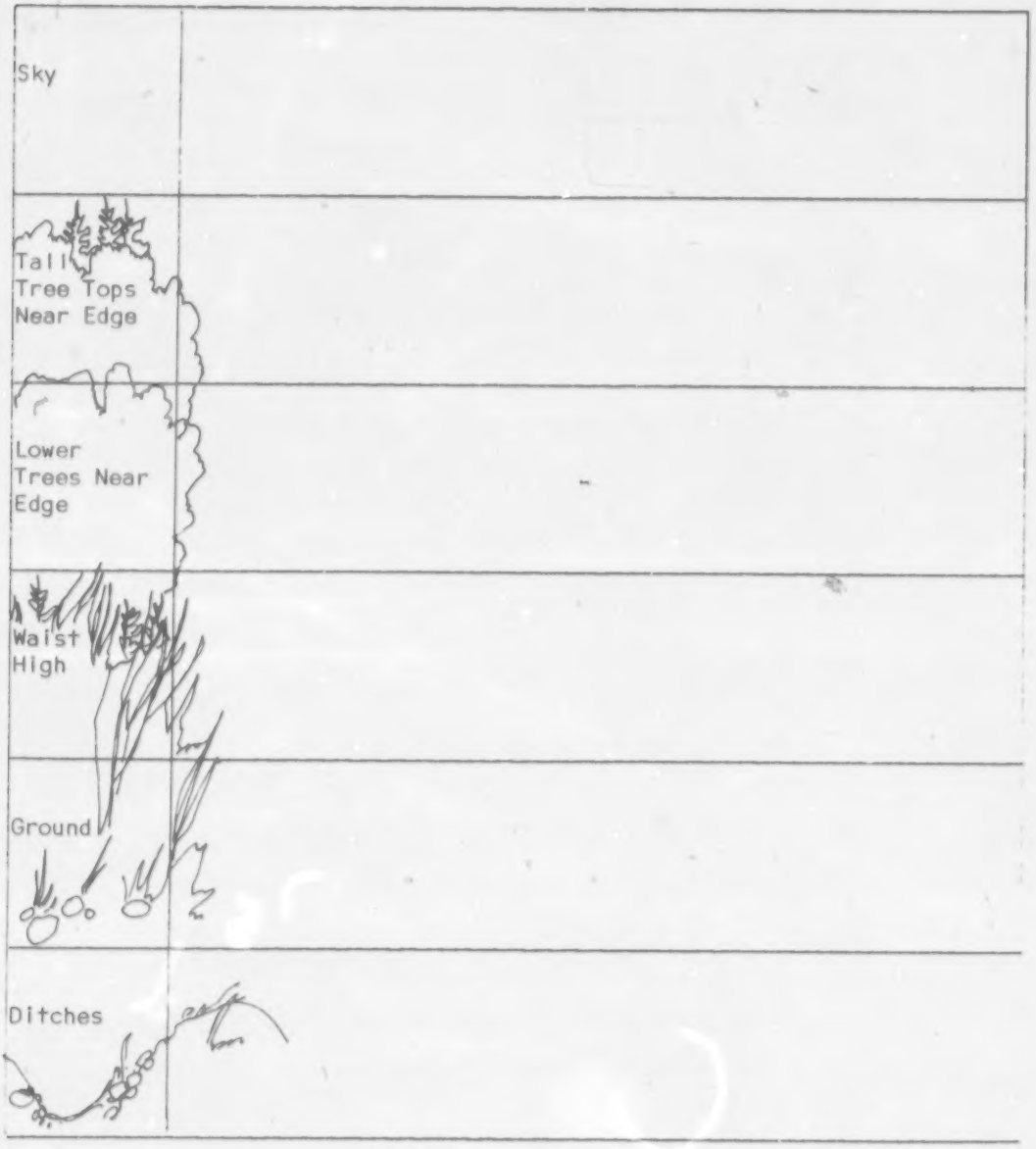
ANIMAL AND ANIMAL SIGNS ON THE LAKE SHORE



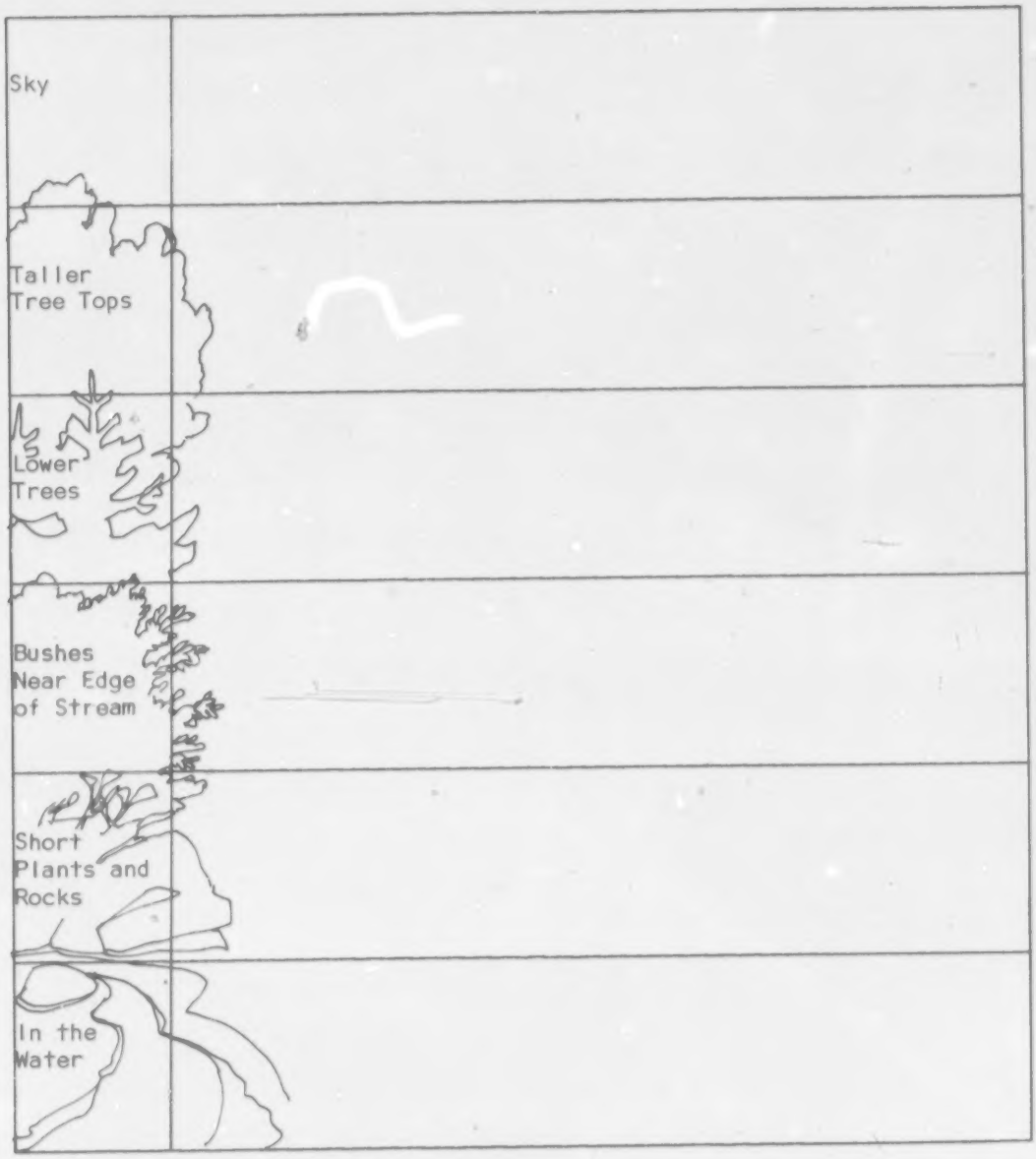
ANIMAL AND ANIMAL SIGNS IN THE FOREST



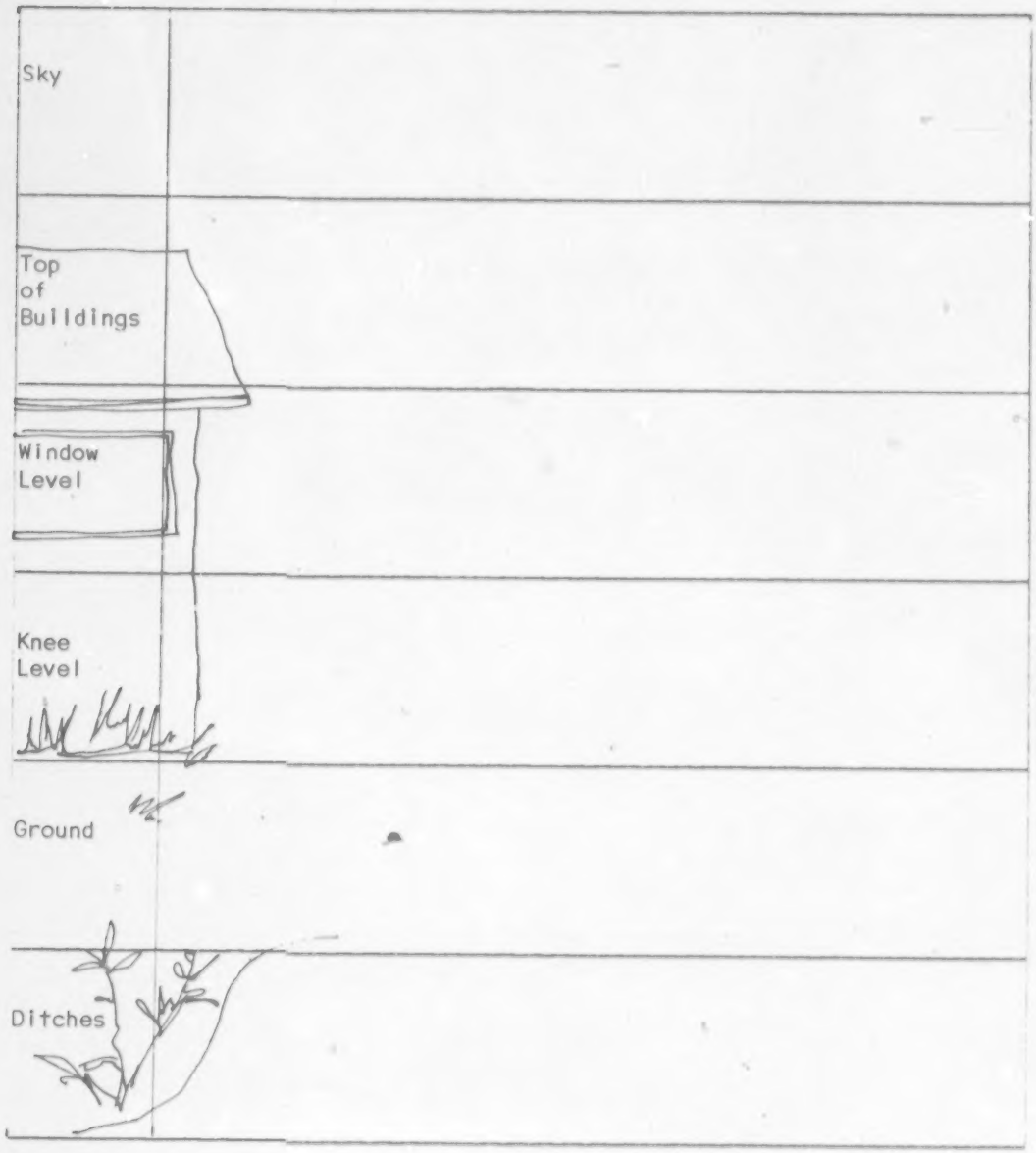
ANIMAL AND ANIMAL SIGNS IN THE FIELD



ANIMAL AND ANIMAL SIGNS NEAR THE STREAM



ANIMAL AND ANIMAL SIGNS AROUND THE ELC BUILDINGS



ANIMAL TRACKING

Most students do not see animals other than birds when they are in the field. However, winter is an ideal time to observe the habits of some animals even if they are not seen.

Equipment

Center Provides	You Provide
Binoculars	Note Paper
Clipboards	Pencils

Procedure

1. In the field west of the dorms or at some other open location, have the students fan out and look for animal tracks in the snow. As soon as a set of tracks is found, have the students gather, taking care to not destroy the tracks.

Discussion

1. Can the students determine which way the animal was going?
2. Can the students determine how long ago the animal was there? If the tracks have fresh snow in them, you know he must have gone by before the fresh snow began or if there is not as much fresh snow in the track as on the ground, you can make a time estimate. If the track has melted some, then that also can help you estimate its age.
3. Follow the tracks. Are there any signs that the animal stopped to eat anything?
4. Did the animal lie down anywhere?
5. Did the animal meet any other animals and travel with them for any distance?
6. Did the animal's path cross the path of any other animal? Which animal went by the point of crossing first?
7. Can you identify the animal by its tracks? Have the students make a sketch of the track so they can look it up later.
8. Did the animal have a limp?
9. Did the animal drag its tail?
10. Did the animal go through some places you can't?

AN ANIMAL'S VIEW

Equipment

Center Provides	You Provide
Polaroid Cameras	Polaroid Square Shooter
Clipboards	2 film
	Pencils
	Note Paper

Procedure

Animals and birds that students may find, or find signs of, around the Environmental Learning Center include deer, moose, beaver, rabbits, squirrels, porcupines, ruffed grouse, frogs, mice, blue jays, hawks, eagles, shrews, and chipmunks.

1. Have the students draw at random or pick an animal that they want to describe.

2. Set time and area limits.

3. Send the students out to photograph things they would do or use if they were the animal they picked. You may want to suggest that they photograph:

    a. The tracks that their animal makes.
    b. The food their animal would eat.
    c. An animal or thing that might be a danger to them.
    d. Where they would build their home or seek shelter.
    e. Anything else suggestive of their animal.

NOTE: This lesson may be done without cameras. The students could either write a few lines about each topic or draw a sketch depicting each. However, with the photographs the students must go out exploring rather than just drawing on previously gained knowledge.

Discussion

1. What was your animal?

2. What did you photograph (or draw) that represents a danger to your animal? Why?

3. Did you photograph (or draw) any food that your animal could use?

4. Do you have a photograph (or drawing) of where you would build a nest? Why did you choose that location?

5. Were you able to photograph (or draw) any signs of the animal you represented?

IMPORTANT: If using Polaroids, please remember:

1. DO NOT toss away the film packet. It has been found that small animals eat this discarded material which contains a chemical that is deadly to wildlife.

2. If some of the developing chemical should get on your hands, wash the exposed area immediately in water or snow. If you don't, the chemical can cause a skin burn.

3. Work as a team with your partner. Operating these cameras can be difficult, so help each other out.

4. Remember to keep the cold pack as warm as possible, or your Polaroid print will not develop.

5. Be sure that either you or your partner has a watch. Remember, allow 90 seconds for your picture to develop inside the cold pack.

CAMOUFLAGE AND ADAPTATION

Why does the frog have a mottled green back? How did the viceroy butterfly come to mimic the coloration and habits of the monarch butterfly? Why do the killdeer and the small-mouth bass have light colored undersides and darker colored backsides?

Through time the animal species native to northeastern Minnesota have evolved to become what they are today. Only those animals that were able to adapt to the stresses of their environment survived, resulting in those specific characteristics that insured survival being passed on from generation to generation.

This activity will explore some of the facets of evolution, adaptation and camouflage. It gives the students an opportunity to observe a real example of adaptation and/or camouflage.

Equipment

Center Provides	You Provide
Clipboards	Notepaper or Activity Cards
Hip Boots	Pencils
Net	
Plastic Specimen Jars	
Hand Lenses	

Procedure

This activity is in four parts. Each activity is to be completed by teams of students.

1. Activity A: Define the words adaptation, camouflage and evolution. Decide what adaptation and camouflage have to do with evolution.

2. Activity B: List some of the ways animals use camouflage and some of the ways they have adapted.

3. Activity C: Ask the students to list any animals native to northeastern Minnesota that use camouflage effectively. After each activity is completed, the instructor should record the findings of each team on a blackboard for all to see.

4. Activity D: In the field have each team attempt to find an example of adaptation and camouflage. Upon locating a specimen, instruct the students to describe it and determine how it uses camouflage and has adapted, being sure to consider the animal's place in the environment. When finished, have the groups return to the classroom and present their findings to one another.

CAMOUFLAGE AND ADAPTATION

This activity will deal with methods that animals of all types have developed to insure their survival. The first three activities will be completed here in the classroom, and the last activity will be done in the forest.

Activity A:

Working together, decide on good definitions for each of the following terms. Your teacher will ask you to present them to the total group. Do not go on to the other activities until told to do so

Adaptation:

Evolution:

Camouflage:

In what ways are the three related?

Activity B:

List a number of animals and the ways they use camouflage. Use the word "adapt" as often as you can.

Animal	Method of Camouflage

CAMOUFLAGE AND ADAPTATION

Activity C:

List animals that live in northeastern Minnesota and the methods of camouflage that they have developed.

Animal	Methods of Camouflage

Activity D:

Your teacher will give each team a selection of equipment. Use it to observe or collect animals that have adapted to their environment. For each animal that your team finds, complete the following chart. Do not destroy or harm in any way the animals that you are observing. If you bring any back to the classroom, please return them to their homes.

Kind of Animal	Example of Camouflage and reasons for:	Examples of Adaptation and reasons for:

MAMMALS AS CONSUMERS

Northeastern Minnesota is the home of approximately 52 species of mammals ranging from the tiny pygmy shrew, weighing as little as a dime, to the mammoth moose, weighing almost 1200 pounds. Both of these are warm-blooded, have hair or fur, give birth to their young and suckle their young. Being a herbivore, the moose slowly moves its way through the forest and shallow waters searching for food. A carnivore, the shrew is a bundle of energy darting here and there exploring for insects, eggs and small amphibians. It must consume its weight in food nearly every twenty-four hours.

The mammals of northeastern Minnesota represent the three types of consumers: omnivores, herbivores and carnivores. This activity is designed to help the student discover the relationships among the different types of consumers, as well as to increase the student's understanding of mammals.

Equipment

Center Provides	You Provide
Clipboards	Pencils
	Activity Cards or Notepaper

Procedure

This activity is a three part lesson and is to be completed by teams of students.

1. Activity A: Define the following words: mammal, herbivore, omnivore, carnivore and food chain.

2. Activity B consists of two parts:

   A. List the animals native to northeastern Minnesota with some of their characteristics. Also include which type of consumer they are: herbivore, omnivore or carnivore.

   b. Draw a diagram indicating the relationships among the mammals. The instructor may want to clarify the role of plants as producers and animals as consumers.

3. Activity C is done outside. Instruct each team to search for mammals and record their findings. When Activity C is completed have the teams return to the classroom and share their findings with the other teams.

MAMMALS AS CONSUMERS

This activity deals with mammals and some of their characteristics. The first two activities are completed in the classroom, and the final activity is done in the forest. Do only one activity at a time.

ACTIVITY A

Working within your group, decide on a good definition for each of the following:

Mammal

Herbivore

Carnivore

Omnivore

Food Chain

Producer

Consumer

ACTIVITY B

List a number of mammals native to northeastern Minnesota and some of their characteristics. Use the words you defined in Activity A.

MAMMALS	CHARACTERISTICS	TYPE OF CONSUMER

MAMMALS AS CONSUMERS

Using the mammals you have listed, draw a diagram which demonstrates their relationships to one another. If the mammals are omnivores or herbivores, indicate in your diagram their relationships to other living things.

ACTIVITY C

When you have finished your diagram and shared it with the other teams, you will be instructed to go into the forest and look for mammals and evidences of mammals. Record as many characteristics as you can, using the same method employed in Activity A and B. Do a diagram on the back of this sheet.

ANIMALS AND EVIDENCE	CHARACTERISTICS

ANIMALS AS CONSUMERS - FOOD WEBS

We often think of animals as being independent of one another and fail to realize that a great deal of interdependence exists among the animals in the forest. Animals found in the vicinity of the ELC represent the three types of consumers, omnivores (animals eating plants and meat), herbivores (animals eating plants) and carnivores (animals eating meat).

Equipment

Center Provides	You Provide
Clipboards	Paper
Hand Lenses	Pencils
Plastic Sample Cups	

Procedure

1. Before your arrival at the ELC, your students should know the following terms:
   - Mammal
   - Herbivore
   - Carnivore
   - Omnivore
   - Food Web
   - Producer
   - Consumer

2. Before arrival at the ELC, have students draw or be familiar with a food web.

NOTE: Most science books have excellent food web diagrams.

3. At the ELC have students determine through observation what part animals play in the food webs of northeastern Minnesota. To do this, the students should look for plant tops that have been eaten, leaves that have been chewed, animal carcasses to see what is decomposing them, droppings to determine what the animal has eaten, and other evidence of food webs.

Discussion

1. Have the students draw a food web that included the items they found while at the ELC.

2. Are there any items they feel are more important than others in the food web? Why?

INSECT STUDY

Equipment

Center Provides	You Provide
Hand Lenses	Note Paper or Activity Sheet
Clipboard	Pencils
Plastic Collecting Cups	

Procedure

1. Give each student or team of students one collecting cup, a pencil, a data sheet and a clipboard.

2. Review the data sheet with the students, discussing the kinds of answers (data) they might record.

   Example: "Where was it found"? Answer: "Under a rock," "On a leaf," "In the stream," etc.

3. Tell the students to collect one insect and either return to a central location to continue making observations, or stay at the location where they found the insect and fill out the data sheet.

4. Discuss with the students what they observed about their insects.

5. Display the data so other students may see what has been found and recorded.

DATA SHEET: INSECT INFORMATION

Discovery Information

1. Where was it found?_____

_____

_____

2. What was it doing?_____

_____

_____

3. Where does it live?_____

_____

_____

Details

4. How many legs?_____

5. How many eyes?_____

6. What do you think it eats?_____

_____

_____

7. Can it fly?_____

8. Is it helpful to man?

_____

9. Draw a picture of your insect.

10. Return your insect to its home.

COMMENTS: _____

_____

_____

ESTIMATING INSECT POPULATIONS

Insects which do not fly far can be captured, marked, released and recaptured to determine how many live in a given area. At the ELC several locations are suitable for this activity. The baseball field south of the campfire site, the area of new aspen growth adjoining the baseball field, the bog behind dorm four and the picnic area near the Flathorn Lake Beach are good sites.

Equipment

Center Provides	You Provide
Insect Nets	Marking Pens
Thermometers	Paper
Clipboards	

Procedure 1

1. When you arrive at the study site have the students determine the boundaries of the area and describe it in their notes.

2. Record the temperature, shadiness, moisture, vegetation and other characteristics of the area.

3. "Sweep" the area with insect nets and collect one species. Grasshoppers or crickets are excellent for this.

4. Mark the species you have collected. This can be done by using a felt tipped pen and carefully making a mark on the insect's back.

5. Release the insects throughout the study area.

Discussion 1

1. Why are well-defined boundaries important?

2. Were there sub areas within your area that had more insects than were found elsewhere? Why do you think they were there?

Procedure 11

With the same students or a different group, return to the area either after lunch or at the same time on the following day. It is better to do the second part of this study under similar temperature and sunlight conditions so the following day would probably be the best time to complete the study.

1. Make sure the students know the boundaries of the area.

2. "Sweep" the area and collect all the insects of the chosen species.

3. Count the <u>total</u> number of the chosen insects and the number that are marked.

4. Use the following ratio to estimate the total population:

$$\frac{P_1}{M_1} = \frac{P_2}{M_2}$$

P_1 = total population

M_1 = total number of marked individuals

P_2 = total number collected on second sweep

M_2 = number of marked individuals in second sweep

If you captured 250 grasshoppers the first time and marked and released them, and 280 were captured on your second sweep, 35 of them with your mark, then:

$$P_1 = \frac{P_2}{M_2} \times M_1 = \frac{280}{35} \times 250 = 2{,}000$$

<u>Discussion 11</u>:

1. Why were well-defined boundaries important?

2. Would it have helped or been important on the second sweep to also sweep the area approximately 10 feet outside of the boundaries?

3. Can this method be used on all animals?

<u>Precautions for the teachers</u>.

1. The students must handle the insects with care or a wing or leg will be damaged and the study will not be as effective.

2. Students should sweep the insect net back and forth in front of them and not chase after grasshoppers that are "getting away". If they chase one and on the second sweep do not, the results will be inaccurate.

3. If one group of students does the initial sweep and another group does the final sweep, then the first group must record their findings in such a way that the others know exactly where the boundaries are and how many insects they caught.

Adapted from: William A. Andrews (ed.) A Guide to the Study of Terrestrial Ecology, Prentice-Hall, Englewood Cliffs, N.J. 1974.

BIRDS OF NORTHEASTERN MINNESOTA

From ancient times birds have appealed to man. They have furnished themes for tales of adventure, poems, music and even primitive religions. Today there are innumerable people who use much of their leisure time to acquaint themselves with birds in their native surroundings. This aesthetic enjoyment of nature offers a wealth of interesting and exciting experiences.

All birds are warm-blooded (capable of maintaining a constant body temperature), lay eggs from which the young eventually hatch (oviparous), have two legs, a bill or beak, feathers and are capable of flight. (There are a number of special adaptations in the bird's structure which make it possible for the bird to fly, i.e., hollow bones, air sacs, streamlining, centralization and balance of body muscles and bones.)

Over 180 species have been recorded in the Superior National Forest. The most common birds around the Center are ravens, red-winged blackbirds, woodpeckers, jays, wrens, nuthatches, chickadees, thrushes, waxwings, vireos, warblers, grosbeaks, finches, sparrows and assorted hawks, ducks and owls.

While conducting this activity, emphasize the development of good observational skills which will lead to easier identification in the field. Identification is important because a positive identification can lead into a number of areas such as habitat comparisons, ecological niches observations and interactions between species.

Standard procedure in puzzling out descriptions is to ask if the bird is smaller than, as big as, or larger than a robin or sparrow. Once one gets some idea of size, specific questions about obvious features such as crest, cap, eye lines, breast marks and wing bars should narrow the possibilities. Perch preference, feeding habits and habitat are also helpful information. Even with these clues, some identifications will remain impossible.

Equipment

Center Provides	You Provide
Clipboards	Note Paper or Activity Cards
Parabolic Receivers	Pencils
Tape Recorders	
Binoculars	

Procedure

1. Assemble students and have them complete Activity A. Activity A asks the students to write a definition of bird. (See background information). Upon completion of the lesson, students will have an opportunity to re-examine their definition and will most likely change their original definition.

2. After completing Activity A, divide the group into teams. Tell them they will be working together for the rest of the activity, and give them Activity B. This activity asks the teams to list all of the birds that the members know and describe the characteristics that make them recognizable. Give the teams about 25 minutes and then record all of the birds the group has identified, going from team to team and member to member for the final list.

3. When the list is completed ask the teams if it would be possible to find a few categories into which all of their characteristics would fit, and lead them to suggest categories such as size, shape, markings, song, call, habitat, beak shape, foot style, etc.

4. Now give them Activity Card C which consists of a table of observational characteristics to be recorded on paper and on a tape recorder. Ask each group to select a person to fill out Activity Card C, one to carry the binoculars, one to carry the parabolic receiver and one to carry the tape recorder. Send the students into the field with a time limit of one hour to find, if possible, five different kinds of birds.

5. When the teams return, construct a sheet similar to the last activity card and record all of the birds and characteristics. Discuss the findings.

6. Upon completion, ask the students to think about their original definition and, if you like, have them write a new one and compare the two. Hopefully, they will have a great deal more to write about the birds.

BIRDS

Activity A

Define Bird:

Activity B

BIRDS	CHARACTERISTICS

BIRDS

Activity C

FIELD SKETCH & MARKINGS	BEAK & FOOT SKETCH	HABITAT	FEEDING HABITS	SONG & FLIGHT PATTERN.
**Note: size, cap, crest, eyeline, breast marks and wing bars		Perch preference		

APPENDICES

A Equipment

Please keep the following in mind when planning equipment use:

1. Equipment can only be checked out by adults
2. Equipment must be returned in the same condition it was received
3. Do not accept equipment that appears to be damaged or inoperable
4. Check equipment out shortly after arrival and in shortly before departure

Camping Equipment

24	17 Foot canoes
1	6 Place canoe trailer
80	Canoe paddles
71	Helmsman life jackets
23	Oars
26	"Horse collar" life jackets
15	Canteens
20	Foam pads
37	Sleeping bags
4	Optimus 111B camp stoves
20	Pint plastic jars
29	Quart plastic jars
12	#4 Duluth packs
14	#3 Monarch Cruiser packs
3	Small packs w/frames
4	Small packs w/out frames
4	Sven saws
5	Swede bow saws
6	Reflector ovens
4	Grills
2	Grills w/folding legs
4	Utensil kits
8	#1 Cook kits
2	#2 Cook kits
5	Misc. cook kits
10	Two-man tents
4	10 x 12 Tents
4	8 x 10 Tents

Winter Recreation Equipment

6	Pair of metal snowshoes
10	Pair children's plastic snowshoes
2	8' Toboggans
2	Plastic toboggans w/poles and harness
95	Pair cross-country skis w/cable bindings
90	Pair snowshoes w/thong bindings
95	Pair ski poles

Optical and Measuring Equipment

1	Burleise funnel
190	Clipboards
1	Stereo electric microscope
2	15X Stereo microscope
4	30X Stereo microscope
4	50X Microscope
3	10X Spotting scopes
29	Binoculars
60	Hand lenses
4	Dissection pans
1	Air pump
11	Plastic buckets
4	Minimum/maximum thermometers
10	Bi Therm pocket thermometers
28	Thermometers
1	20' Tape
3	50' Tape
5	100' Tape
3	Rulers
36	Isabella quadrangle maps
41	Silva compasses
10	Brass compasses

Astronomy Equipment

1	Telescope 614 Galazy F-700mm D-60mm
1	55mm Edmund eyepiece
2	6mm Edmund eyepiece
2	28mm Edmund eyepiece

Audio-Visual Equipment

16	Bell Howell cassette recorders w/mikes, plugs, cases
3	Overhead projectors
2	Folding film screens w/tripods
2	Wall screens
1	Megaphone
2	Extension cords
2	Kodak slide projectors w/3.5 4" lens
1	Kodak slide projector with 4-6" zoom lens
1	Sawyer slide projector
2	140 Slide trays
1	80 Slide trays
1	Sawyer tray
31	Cassette tapes
2	Wollensak reel-to-reel recorders
2	Sony cassette recorders
6	Parabolic receivers
1	16mm Bell Howell 16mm projector, Model 1545B
1	16mm Bell Howell 16mm projector, Model 1552
1	Filmstrip projector w/feeder
1	Record player(assorted tapes - reel to reel)
5	Metal take-up reels (16mm)

FILMS: Cheman, Incident at Wolf Hill, Death of a Legend, Temples of Time, Rise and Fall of the Great Lakes, Play Safe, The Forest, Planting Isn't Enough

Terrestrial Equipment

6	Surveying tripods
12	Tree planting bars
8	Log scale sticks
1	Gradient stick
3	Log scale bars
5	Soil thermometers
3	Increment borers
2	Increment hammers
4	Mineral sets
10	Soil samplers
4	Plane tables w/tripods
15	Insect nets
2	Live traps
34	Meter sticks
10	Hand trowels

Aquatic Equipment

8	Rowboat w/oars
22	Pair hip boots
2	Large seines
4	Small seines
6	Dip nets
4	Ice augers
5	Metal ice dippers
36	Hand dip nets
2	Ekman bottom dredges
2	Kemmerer water samplers
2	Secchi discs
2	Depth measurer

Test Kits

1	Simplex soil test kit
8	Co2 Hach kits
5	Ph Hach kits
2	Hach ammonia kits
10	Hach dissolved oxygen kit
3	Co2 Eduquip
3	Nitrate hardness Eduquip
3	Acidity kits Eduquip
1	No2 kit Eduquip
3	Lamotte soil testing kits

B A bibliography of resident activity sources

The following publications are primarily collections of lesson plans and related material that can be used for environmentally-oriented lessons.

Brennan, Mathew J. ed. People and Their Environment, Teachers' Curriculum Guide to Conservation Education. Chicago: J.G., Ferguson Pub. Co., 1968.

Brown, Robert W., and G.T. Mouser. Techniques for Teaching Conservation Education. Minneapolis: Burgess Publishing Co., 1964.

ES Cards. Reading, Mass.: Addison Wesley Publishing Co.

Examining your Environment Series. Minneapolis, Mn.: Winston Press. Topics include:

- Astronomy
- Birds
- Mapping
- Mini-climates
- Pollution
- Running Water
- Small Creatures
- Snow and Ice
- The Dandelion
- Trees
- Your Senses

Group for Environmental Education. Our Man-Made Environment. Washington, D.C.: American Institute of Architects, 1969.

Hiros, John E. Inviting Involvement with History. Browns Mills, J.J.: Conservation and Environmental Science Center, 1968.

Jackson, John Y. Land Use - Concern - Challenge - Commitment. Browns Mill, N.J.: Conservation and Environmental Study Center, 1968.

Mason, Fred R. Tuning Up the Five Senses. Browns Mills, New Jersey: Conservation and Environment Study Center, 1968.

Mini-Units for Environmental Education. St. Paul, Mn.: Minnesota Department of Education. (Includes 30 topics plus bibliography).

National Wildlife Foundation. Washington, D.C. at least 17 different booklets each with one topic covered in 3 to 15 lessons.

Russell, Helen Ross. Ten-Minute Field Trips, Using the School Grounds for Environmental Studies. New York: J.G. Ferguson Publishing Co., 1973.

Tempe, Gertrude G., and David F. Moore. Education for Survival. Morristown, N.J.: North Jersey Conservation Foundation, 1970.

White, Roy C. ed. Environmental Education Handbook. Helena, Mont.: Department of Public Instruction, 1972.

Books which deal primarily with philosophy and methodology of environmental education:

Brainerd, John W. Nature Study for Conservation. New York,: MacMillian Co. 1971

Freeburg, William H., and Loren E. Taylor. Programs in Outdoor Education. Minneapolis: Burgess Publishing Co., 1963.

Hammerman, Donald R., and William M. Hammerman, eds. Outdoor Education, a Book of Readings. Minneapolis: Burgess Publishing Co., 1968.

Hammerman, Donald R. and William M. Hammerman. Teaching in the Outdoors. Minneapolis: Burgess Publishing Co., 1973.

McInnis, Noel. You are an Environment. Evanston, Ill.: Center for Curriculum Design., 1972.

Schoenfeld, Clay, ed. Outlines of Environmental Education. Madison, Wisc.: Dembar Education Research Inc., 1971.

Smith, Julian W., Reynold E. Carlson, George W. Donaldson, and Hugh B. Masters. Outdoor Education. Englewood Cliffs, N.J.: Prentice Hall, 1963.

Stapp, William. Integrating Conservation and Outdoor Education Into the Curriculum. grades k - 12. Minneapolis, Mn.: Burgess Publishing Co., 1967.

Subarsky, Zachariah, Elizabeth W. Reed, Edward R. Landin and Barrie G. Klalts. Living Things in Field and Classroom. Minneapolis, Mn.: (Minnesota of Mathematics and Science Teaching Project) University of Minnesota, 1969.

Terry, Mark. Teaching for Survival. New York: Friends of the Earth-Ballantine Book, 1971.

Vivian, V. Eugene, and Thomas J. Rillo. Focus on Environmental Education. Glassboro, N.J.: The Curriculum Development Council for Southern New Jersey, Glassboro State College, 1970.

Background reading to help you understand the environmental problems around us:

Carson, Rachel. The Sea Around Us. New York: Oxford University Press, 1951.

Carson, Rachel. Silent Spring. Boston, Mass.: Houghton Mifflin, 1962.

Commoner, Barry. The Closing Circle. New York: Alfred Knoff. (hardback, also paperback).

Commoner, Barry. Science and Survival. New York: Viking Press, 1966.

Dorst, Jean. Before Nature Dies. Baltimore, Md.: Penguin Books, 1971.

Douglas, Donald G., and John R. Stewart eds. The Vanishing Landscape. Skokie, Ill.: National Textbook Co., 1970.

Ehrlich, Paul R. The Population Bomb. New York: Sierra Club-Ballantine Book, 1968.

Fuller, R. Buckminster. Operating Manual for Spaceship Earth. New York: Pocket Books, 1971.

Huth, Hans. Nature and the American. University of Nebraska Press, 1972.

Meadows, Donella H., and others. The Limits to Growth. New York: Universe Books, 1972.

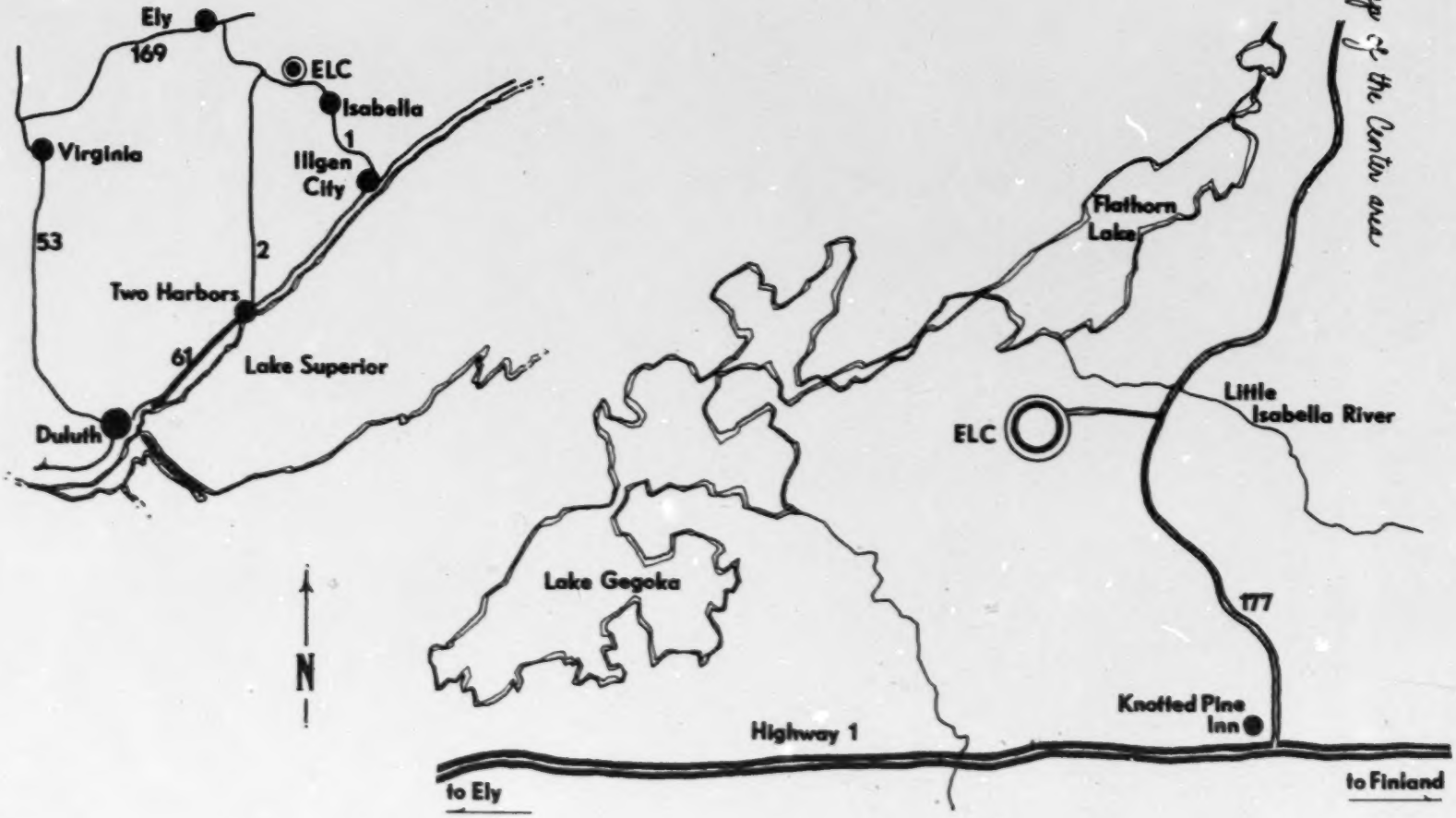
Wagnor, Richard M. Environment and Man. (2nd Edition). New York, W.W., Norton and Company, 1974.

Miscellaneous books worth having:

Bachert, Russel E. Jr., and Emerson L. Snooks, Outdoor Education Equipment. Plans for Easy to Make Items. Danville, Ill.: Interstate Printers and Publishers, 1974.

Conservation Education Association. Environmental Conservation Education: A Selected Bibliography. Danville, Ill.: Interstate Printers and Publishers, 1974.

Getting to the Environmental Learning Center



A map of the Center area